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CIVIL ENGINEERING

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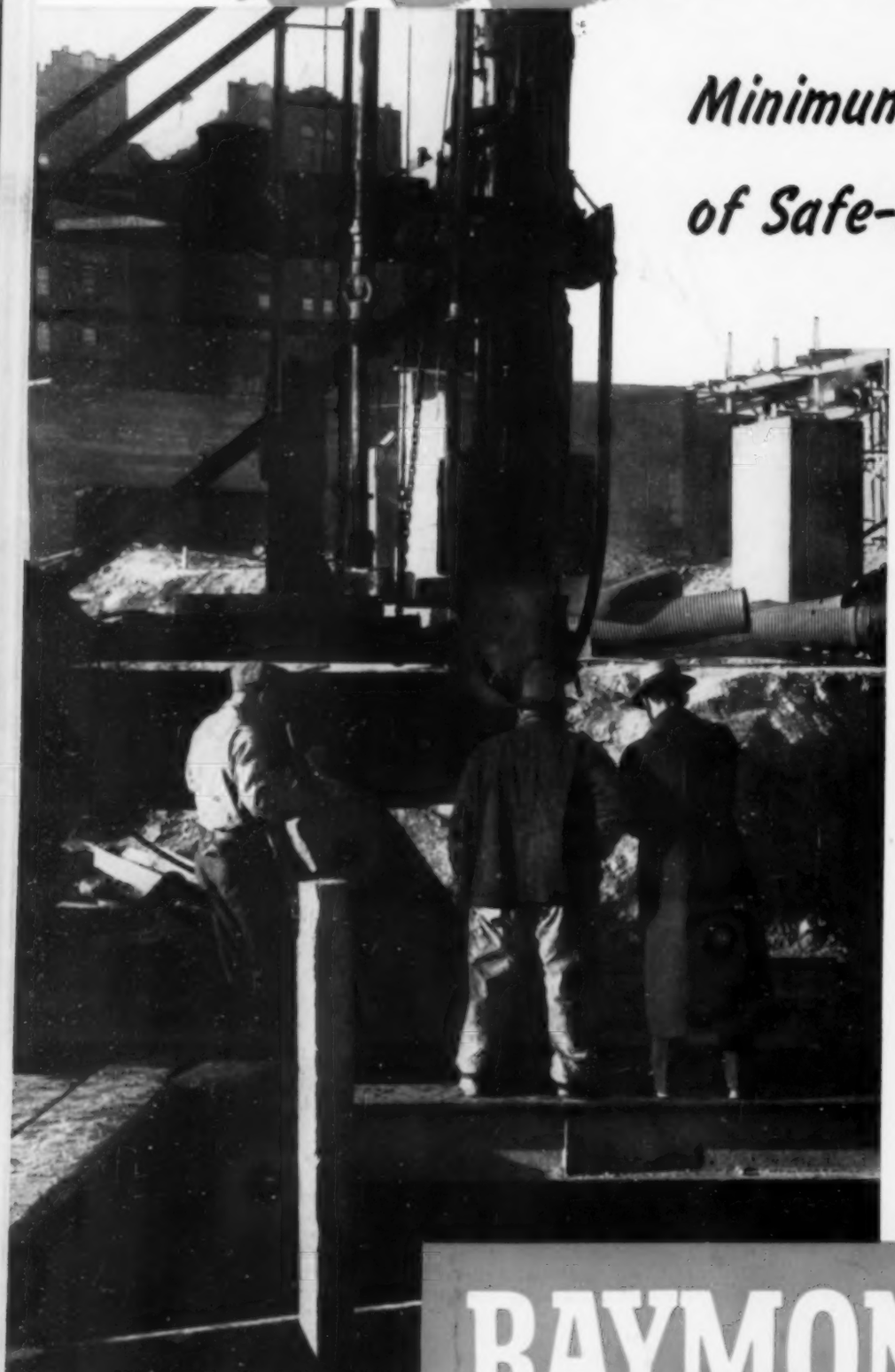
STEEL ARCH HIGHWAY BRIDGE OVER CONNECTICUT RIVER NEAR BRATTLEBORO, VT.
Illustrating Variation in Susceptibility to Fatigue—Hangers Possibly After Many Years, Chords Never (See Page 344)

Volume 10 — Number 6 —

JUNE 1940

THE IMPORTANT FACTOR IN ULTIMATE COST



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Among Our Writers

HERBERT J. GILKEY (Oregon State; Mass. Inst. of Tech.; U. of Illinois, etc.) taught at the University of Illinois from 1921 to 1923, and at the University of Colorado from 1923 to 1931. Since the latter year he has headed the department of theoretical and applied mechanics at Iowa State College. During the war he served with the 29th Engineers in France.

WILLIAM D. DARBY (Valparaiso U., 1914) has maintained a private consulting practice since 1920 and, coincident with this (1920 to 1938), was city engineer of West Allis, Wis. He has been in charge of the design and construction of numerous state and municipal projects.

RALPH WHITMAN (Mass. Inst. of Tech., 1901) was commissioned in the Civil Engineer Corps of the Navy in 1907, with the rank of ensign. His present rank of rear admiral was attained in 1939, in which year he was assigned to his present duty as Public Works Officer of the Third Naval District.

SAMUEL W. MARSHALL, a member of the original Pennsylvania Turnpike Commission, has been chief engineer of the Pennsylvania Department of Highways and has also done considerable consulting work. He is a World War veteran.

CECIL E. PEARCE (Stanford U.) was with the Los Angeles County Flood Control District in 1927 and 1928. As chief design engineer on the Morris Dam and Aqueduct (1928 to 1934), he developed mathematical theories for earthquake-resistant designs. In 1934 he joined the staff of the TVA.

JONATHAN JONES (U. of Pennsylvania, 1906) was with McClintic-Marshall Company for 18 years, designing and constructing the Ambassador Bridge at Detroit during part of this period. Since 1931 he has been chief engineer of the fabricating interests of the Bethlehem Steel Company.

H. L. JOHNSON (U. of Nebraska, 1928; U. of Iowa, 1930) has been in the Corps of Engineers, U.S. War Department, since 1930, serving in a variety of capacities to 1936 and as foundation engineer and geologist on Conchas Dam from 1936 to 1939. In March 1939 he was transferred to Denison Dam.

C. J. VELZ (U. of Minnesota, 1925) as acting chief engineer for the PWA in New Jersey, was active in bringing about the construction of treatment works there, and in 1935 he prepared for the U.S. Senate Committee on Pollution an estimate of the cost of an abatement program for the United States. At present he is professor of sanitary engineering and head of the civil engineering department at Manhattan College.

GEORGE R. THOMPSON constructed the Rouge River plant of the Ford Motor Company. As budget director for the State of Michigan he was in responsible charge of all institutional expansion and construction.

C. FRANK ALLEN was graduated 67 years ago from the Massachusetts Institute of Technology, and most of his professional life has centered about that school, where he taught for almost 30 years. He has been president of the Society for the Promotion of Engineering Education, the Boston Society of Civil Engineers, the New England Railroad Club, and the Massachusetts Highway Association.

GEORGE R. CLEMENS has been engaged on Mississippi River work for the federal government since 1927, first in Washington during preparation of the Jadwin plan, thereafter in Vicksburg (1928) as assistant to the chief of the general engineering division charged with preparing the "308" reports. Since 1932 he has been senior engineer with the Mississippi River Commission.

VOLUME 10 NUMBER 6

June 1940

Entered as second-class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1102, Act of October 2, 1917, authorized on July 5, 1918.

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Printed in U. S. A.

CIVIL ENGINEERING

Published Monthly by the

AMERICAN SOCIETY OF CIVIL ENGINEERS

(*Founded November 5, 1842*)

PUBLICATION OFFICE: 20TH AND NORTHAMPTON STREETS, EASTON, PA.

EDITORIAL AND ADVERTISING DEPARTMENTS:

33 WEST 39TH STREET, NEW YORK

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SUBSCRIPTION RATES

Price 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

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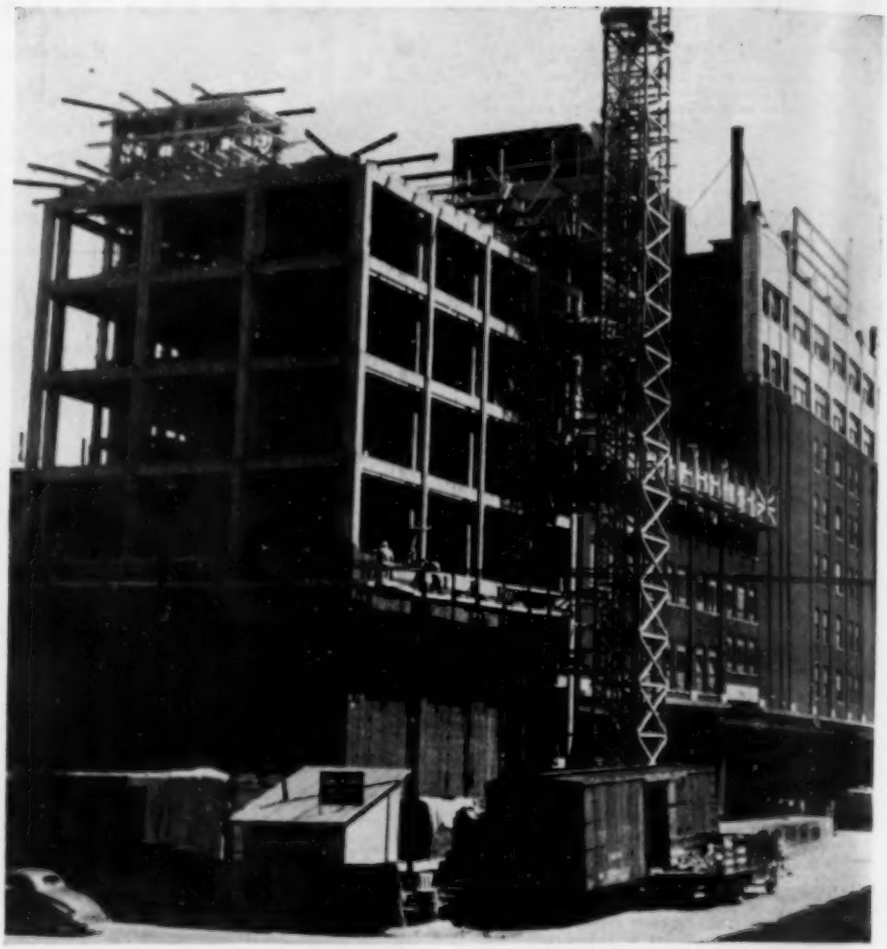
See Sweet's Catalogue

RAYMOND CONCRETE COMPANY

140 CEDAR STREET • NEW YORK, N. Y. Branch Offices in Principal

'INCOR' SAVED $1.96 NET PER CU. YD. OF CONCRETE



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Outside walls are of double concrete frame construction with cork insulation; columns and slabs throughout are covered with cork. Total elapsed time of one month and 8 days for completion of concrete frame indicates good job organization plus 'Incor' operating economies. Heavy rains fell on two of the floors an hour or so after troweling the finished concrete. The contractor states that 'Incor' saved him the cost of re-topping.

Typical of 'Incor's economies in all kinds of concrete work the country over. And a 13-year performance record, exclusive with 'Incor'*, proves long-time durability of this first high early strength Portland cement. Write for copy of "Cutting Concrete Costs." Lone Star Cement Corporation, Room 2272, 342 Madison Avenue, New York.

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Addition to Jerpe Cold Storage Co. Building 12th & Dodge Sts., Omaha, Nebraska.

Engineers: Smith, Brubaker & Egan, Chicago.

Contractor: John Lof & Sons, Omaha.

1000 cu. yd. of concrete . . . 7 stories and roof.

Savings to contractor in regular salaries, supervision and overhead—6 weeks at $380	$2280
Savings, 1½ floors of shores .	135
Rain on 2 floors, 'Incor' saved re-topping	300
Total 'Incor' Saving . . .	$2715
Less Extra Cost of 'Incor' .	750
Net Saving	$1965

or $1.96 per cu. yd. of concrete.

* * *

6 weeks' earlier occupancy meant $10,500 extra income for owner.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Launching a Career

"I Looked Behind to Find My Past and Lo It Had Gone Before"

EXCERPTS FROM A TAU BETA PI INITIATION TALK, BEFORE THE IOWA STATE COLLEGE CHAPTER, APRIL 1, 1940

By HERBERT J. GILKEY, M. AM. SOC. C.E.

PROFESSOR AND HEAD, DEPARTMENT OF THEORETICAL AND APPLIED MECHANICS, IOWA STATE COLLEGE, AMES, IOWA

MUCH that you as young graduates can do will promote success; nothing can assure it. If you would succeed professionally you must: (1) avoid those things that are recognized as being lethal to professional success, and (2) do those things that promote professional good health. True, adherence individually to these tenets does not insure success, but statistically such adherence has been proved to be the stuff of which success is made.

Almost from birth you have been blessed, or cursed, with advice. For some people wholesome advice is like food, the nutriment and the vitamins being absorbed to promote growth and vigor, the remainder passed on as roughage. Others develop an immunity, and advice goes through them like water through a pipe. Still others are allergic to the stuff; it nauseates them.

Establish Professional Status.—If it is your will to grow, you will do well to give yourself the benefit of every legitimate break. Upon your graduation the first of these will be to establish your professional status by affiliating with the appropriate professional society. To do this will not insure your success any more than neglecting to do it will foredoom you to failure. You will at least be planting the seeds of your professional future in good soil with sunlight and moisture at hand.

To those who have experienced the benefits that accrue from such membership, it is discouraging to note how frequently the experience record of an engineer of five, ten, or twenty years' standing shows:

Publications: None

Membership in professional organizations: None

For various good reasons not every engineer can publish; but non-affiliation with at least one good professional organization seems to indicate only indifference and a lack of technical perspective.

Environmental Opportunities are yours. Make the most of the important ones just ahead. As a junior engineer or an inspector you may find yourself rather closely associated with laborers and artisans. By alert open-mindedness, you can learn much of the laborer's point of view, his problems and his philosophy of life, work, and society. Here you have an opportunity to view labor unions in their relationship to the individuals whose entire working existence is bound up in them. You may or may not approve of the union ideals, their methods, or their leadership; but that engineer who rises to a place of responsible management without having acquired a sympathetic understanding of the laborer and his problems has missed a great opportunity. Moreover, you may well devote a little advance thought to the extent to which you would be willing to accept union aims, union ideals, and union methods as proper ones for adoption by your own professional group.

You may find yourself a draftsman or a designer among experienced men who have grown old and possibly discouraged and sour on the job. This rather disheartened, white-collar middle class constitutes an important engineering group. You will do well to embrace an opportunity to analyze these men objectively. Ask yourself why they are rutted where they are—are the faults with the system or with the men? Is their attitude inevitable or might there be ways to inspire them with renewed interest, loyalty, and effort? Remember that what for them represents the end is for you but the beginning. Their job may resemble your job, but their careers are not your careers. Sympathize if necessary, understand if possible, explain and extenuate; but do not adopt any other man's ready-made philosophy until and unless you are convinced that it also fits your own case.

Your Apprenticeship.—Experience will come while you are serving your apprenticeship. "Report on this"; "check that"; "prepare me a short memorandum"—usually an element of hurry is present. Even then it is invariably better to be right than to be fast. Many a feverish young man has gotten himself unfavorably tagged by turning in ill-considered memoranda under such circumstances. For others such assignments have proved to be a step to progress by opportunely attracting

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favorable notice. It is often better not to know at all than to know rapidly but inaccurately; correctly but sloppily or ungrammatically.

You are likely to find yourself irked at the "extreme conservatism" of your superiors, or at their reckless and finicky use of the red pencil on items of seemingly minor importance. You may feel with considerable justification that you are not only needlessly restrained but that the boss receives more than his share of recognition for your work. If under these abuses, real or fancied, you can maintain a sufficiently objective attitude to avoid a blow-up or a long spell of sulkiness engendered by self-pity, you should be able to turn these experiences to excellent future account. Determine that the future shall not find you blindly doing what now seems unfair or ill-advised in others. Your experience will not be unique, however, if from the vantage point of maturity you find yourself almost affectionately grateful to some of those "hard-boiled," "fault-finding," "selfish" superiors, from whose rigorous training, sound judgment, and professional idealism you secure so much that you later learn to value.

Discipleship.~Grasp every opportunity to study at closer range those men who have succeeded in a worthy sense. Blemishes you will find; expect this, discount it in advance and remember that for every valid case of success there are reasons—success doesn't just happen. Study those you admire; find out what made them click and why they tick. When an apprenticeship leads to admiration and emulation it becomes discipleship.

Achievement begets achievement. Like radium it impresses itself upon everything that comes within its zone of influence, and rarely has there been a man of character and attainment who did not become a nucleus from which leaders emanated. Of a man who had brilliance without bigness, it was once well said, "He missed the privilege of having had a contact with a great mind."

At this stage of your career it is probably more important that you see than that you be seen. Better to have passed unnoticed than to have had the spotlight catch you less than fully clothed with competence. To have been unconsciously overlooked is less of a misfortune than to have been consciously eliminated.

Changing Jobs for a young man often is awkward. No matter how lucrative the opening, your first consideration must be for your current employer. If your employer is fair and reasonable he will always release you. Not all employers are reasonable, unfortunately. Every affiliation you have fills a place in your record. If you "quit a man cold," or leave him disgruntled, you may at some later date suffer severely even though you may not be actually at fault.

A man's professional record is a delicate and precious thing. It should always be actively in his consciousness. Many a man has blocked the road ahead when he thought he was only burning a bridge behind. Occasional changes broaden one's backlog of experience and are likely to be beneficial. Make your changes as painlessly as possible and do everything in your power to leave a friend behind you; one who wanted you to remain and who will welcome you back.

References and Friendships.~You will be frequently needing references and most men deem it an honor to be asked, providing the selection is valid. But to offer as references men who may be forced to say, "Our contact was limited and purely social," is not likely to be helpful.

College professors and former employers with whom you really did have contact are always valid references. Many suitable character references cannot qualify properly as technical references. It is not always essential to advise a man that you are using him as a reference, but it is often wise to do so, or to secure his permission. Sometimes you will do well to refresh his memory.

Friendships and congenial social contacts are among the finest things that life has to offer. They should be cultivated and treasured for their own sakes—not as wedges or as professional chisels. Such things frequently prove to have an important bearing upon one's professional destiny, but that bearing should be incidental and accidental rather than a result of scheming or of conscious design. Like a check, a friendship is likely to be canceled when cashed.

Big Little Things.~A non-business letter from a young man written upon his company's stationery, themes written upon some hotel letterhead, may be legitimate; but to one who looks askance that explanation is not apparent. Likewise at times a Pullman towel or a hotel ash tray is an embarrassing possession. Small items sometimes lead to damaging deductions.

In writing, an impression of dissatisfaction may be legitimate and fully justified, but the prospective employer is likely to be in no position properly to appraise that aspect; he only wonders if the applicant may not be hard to satisfy and a bit restless. What I am trying to say is that in all matters, and especially those which involve correspondence, ask yourself whether or not some small thing will raise a question that may be awkward and unanswered.

Disagreements.~You can't afford to be a "yes" man but neither can you afford to be a winner of arguments. The boss may pull some awful boners (who doesn't?) but your primary concern should be to correct the boner rather than the boss—just as painlessly and modestly as possible, always trying to leave the door ajar so that he who was at fault can back down gracefully. The fallacy in attempting to show how big and how right you are is that automatically you show how small and how wrong the other fellow is. That rarely pays.

If there are unpleasant things that must be said it is often best to think them out carefully in advance and to say them orally and without heat. Or consult the oracle in the form of some level-headed friend. Another good policy is to write out what in hot blood you feel the situation demands, then keep it on hand a few days. That is an excellent device for saving postage.

The Main Idea.~For years you have been hearing much of the importance of literacy and coherence in your correspondence; of punctuality and dependability in appointments; and of correctness in dress and address. The importance of these cannot be overemphasized; you should already have them fully in your consciousness.

Of "do's and don't's" there is no end. These comments are offered with the hope that from them you may "get the idea"; for this, like Newton's laws and the Golden Rule, may be generalized *ad infinitum* to cover all manner of specific situations.

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CIVIL ENGINEERING

JUNE 1940

VOLUME 10 NUMBER 6

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Combined Water Tower and Municipal Building

Project at Lake, Wis., Proves Successful on Engineering, Civic, and Architectural Counts

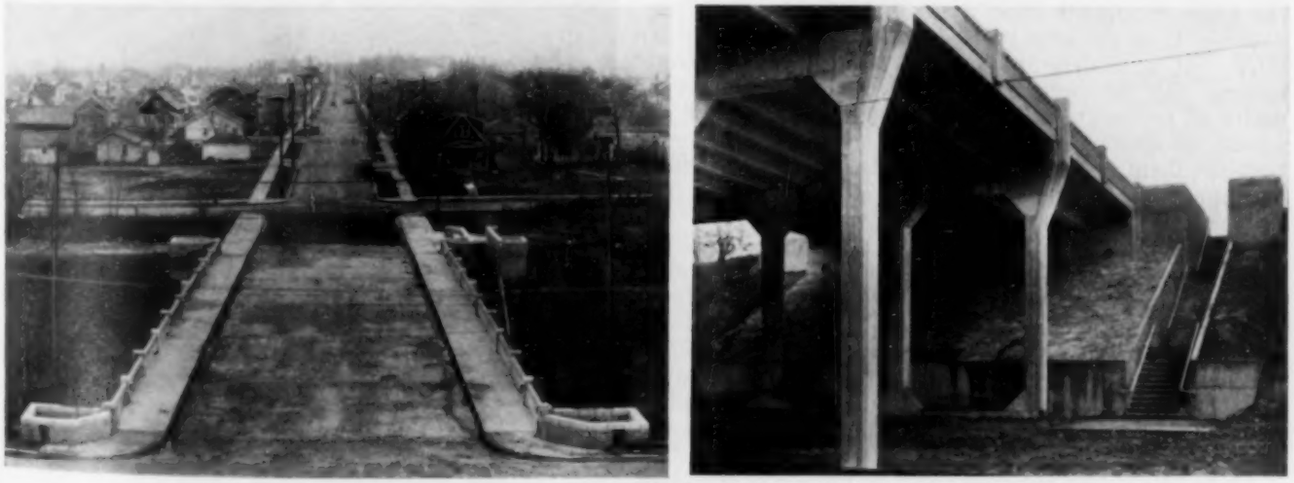
By WILLIAM D. DARBY
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, WEST ALLIS, WIS.

IN the course of its normal development, the town of Lake, Wis., near Milwaukee, had to build a water system, and with it an elevated tank. At the same time it badly needed municipal offices and an auditorium. It remained for Mr. Darby, by a stroke of engineering foresight, to accomplish the merging of these two objectives. The result was most successful. Here he tells of the problems of location to avoid interference with a neighboring airport, of foundations using steel piles, of financing with PWA help, and of construction in steel and concrete. This paper was originally presented at the Wisconsin Engineering Conference held in Milwaukee in March, on that part of the program sponsored by the Wisconsin Section.

IT is very unusual for an engineer to have the opportunity to design and prepare plans for a complete water supply system for a community of five thousand population. Ordinarily a central water supply has been established long before a community reaches that size. However, such a project is nearing completion in the town of Lake, Milwaukee County, Wisconsin. It involved many interesting problems varying from the decision as to the best and most economical supply to the method of financing.

In order to comply with an urgent order issued in 1936 by the Wisconsin State Board of Health, the town board was obliged to make provision for an immediate supply of water for its residents. Unable to make satisfactory arrangements with the City of Milwaukee Water Department, as ordered by the State Public Service Commission, the board found it necessary to investigate all possible sources of an adequate supply. Two sources were open for consideration: (1) Lake Michigan, four or five miles away; and (2) a deep well. A thorough investigation indicated that the supply from the lake would be much more expensive because of the prohibitive cost of an intake and the great length of pipe line required.

Accordingly, an artesian well was drilled to a depth of 1,834.5 ft. Under test the well yielded 950 gal per min with a drawdown of 141 ft. The water has a total hardness of 25 grains per U.S. gallon, and a slight trace of iron. The plant is equipped with a gravity-type Zeolite softener consisting of three filter beds with a rated capacity of 600 gal per min each. In the softening process the water is reduced to zero hardness, after which sufficient unsoftened water is added to produce a final total hardness of 6 grains. The resulting water is



BRIDGE ACROSS RAILROAD CUT, (AT LEFT) FROM WATER TOWER ABOVE, AND (AT RIGHT) FROM BELOW

References and Friendships.—You will be frequently needing references and most men deem it an honor to be the Golden Rule, may be generalized *ad infinitum* to cover all manner of specific situations.

CONSTRUCTION VIEW SHOWING FORMS IN PLACE FOR GROUND STORY OF BUILDING

slightly softer than a supply drawn from Lake Michigan would be.

The entire operation of the water works system, from the deep-well pump through the softening process to the maintenance of a predetermined level in the elevated storage tank, is automatic, requiring the services of only one full-time attendant. All valves are hydraulically operated and the controls are electric.

LOCATION OF TOWER PRESENTS A PROBLEM

One of the interesting problems first faced was that of the proper location of the elevated storage tank. The original site selected was at the point of highest elevation in the water district, at an elevation 160.6 ft above datum. This location is exactly one-half mile north of the Milwaukee County Airport, a large commercial field in which over a million dollars has been invested. Much of this investment consists of federal donations on WPA work. The elevation of the airport is 94.5 ft above datum.

After the town had obtained an option on this elevated site, we immediately apprised the airport authority of our intention to erect the structure. The airport officials then advised the Bureau of Airways of the Department of Commerce, which at once objected to the proposed construction on the ground that the tower would be a serious hazard to planes entering and leaving the field. It was pointed out that the tower would be on one of the radio beams for blind flying and would reduce the availability of the airport for commercial aviation about 40%. At a conference between all the officials concerned, the representatives of the town expressed a desire to cooperate with the aviation officials, but of course recognized that their duty to their constituents required them to erect the tower at the point of greatest economic advantage, that being the site upon which the option had been obtained.

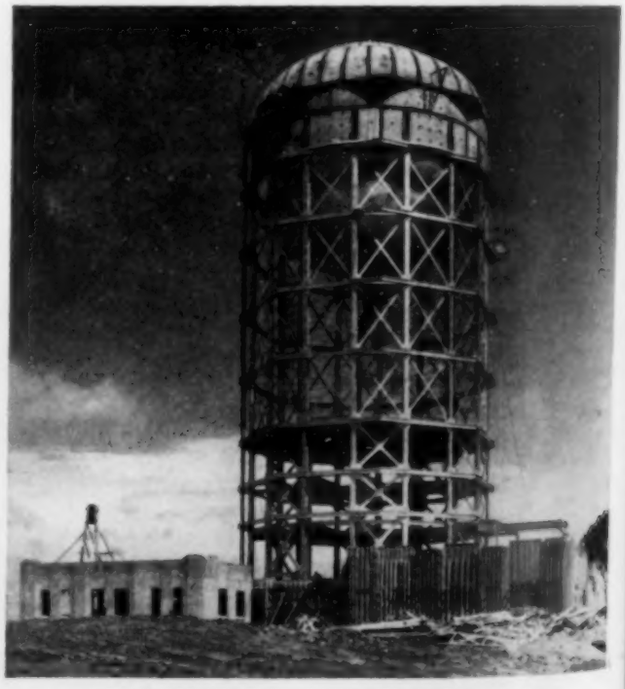
However, the town board offered as a compromise to select a location that would not be damaging to the airport if the federal government would give a PWA grant of 45% based upon the construction cost resulting from the new location. By further cooperation of the various officials this solution was effected. The location chosen, where the tower now stands, is one and one-quarter miles northwest of the airport at an elevation 140 ft above datum.

This new location required the construction of a bridge

built-up area of the water district. However, the position of this railroad is otherwise an advantage to the water works because it made possible the construction of a side track under the bridge for the delivery of salt. When the plant is operating at or near capacity about a carload of salt is used per week. Delivering the salt by carload lots into the wet-salt storage tank and then pumping it up into the plant in solution, effects a considerable saving by eliminating trucking costs. Two manhole openings were built into the roadway slab of the bridge immediately over the openings in the tank so that if at any time there should be an interruption of rail service, salt can be hauled in trucks and dropped from the bridge slab through canvas chutes into the tank. A stairway has been built from the bridge sidewalk down to a platform adjacent to the railroad tracks. The railroad plans to erect a station at this location when traffic warrants it. Thus the people of the town of Lake will eventually benefit further by having a local stop for railway transportation to Milwaukee, Chicago, and intervening points.

One of the outstanding features of the project is the design of the building structure, supporting and surrounding the tower. As shown by the illustrations the general plan and layout is a complete departure from past practice in elevated steel tank construction, for the building is an architectural concrete enclosure that gives a pleasing appearance to the usual unsightly elevated steel structure, and makes available considerable space under and around the supporting structure for municipal offices.

An interesting problem was encountered in that the large and highly variable live load of the water in the tank called for extreme care in the design of the foundations. Numerous test borings taken on the site revealed a large pocket of wet sand under one-third of the area of the main central tower, varying in depth from 5 to 25 ft. The top of this wet strata is about 28 ft below the yard site, and the underlying ground consists of the usual hard blue clay found in the top of the drift in this region. Careful investigation convinced us that this wet



STEEL SUPERSTRUCTURE OF TOWER IN PLACE

BRIDGE ACROSS RAILROAD CUT, (AT LEFT) FROM WATER TOWER ABOVE, AND (AT RIGHT) FROM BELOW

sand was not self-contained. Therefore we could attribute no supporting value to it or to the solid ground above, and it was necessary to drive piles through the wet pocket into the underlying blue clay.

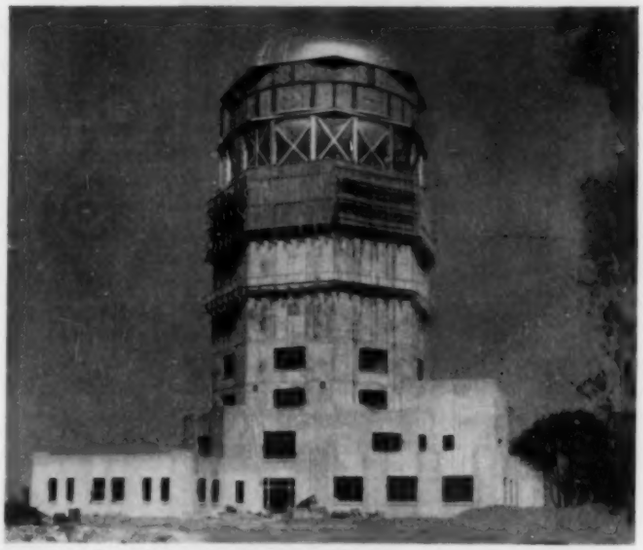
Cold-rolled fluted steel piles were used under all the foundations of the main central tower, but none were used under the outer quadrants. These piles were driven to refusal and afterwards filled with concrete. Because of their form and their construction in one piece, welded watertight, the tubes are at all times straight, and true to form. This additional rigidity, strength and true alinement eliminated the need of using a mandrel. The 16-in. butt of the pile (top) had a steel band welded about its circumference constituting a so-called shoe, on which the driving was done directly, using a single-action steam hammer. Piles were driven to carry a designed load of 50 tons each. The requirement was 100 tons on each test pile driven to refusal and filled with concrete. A hydraulic jack was used in testing. Twenty tons was first applied on the pile and a level reading taken; then additional load in increments of 5 tons per hour (level readings being taken on each increment) until the total load of 100 tons for the test had been reached. The pile was then permitted to rest for 48 hours, after which a final level reading was taken. A total settlement of not more than $^3/_8$ in. was allowed in the specifications for each test pile. The actual settlement was $^5/_{16}$ in. After determining the settlement, the test loads were removed in increments of 10 tons per hour, a level reading being taken on each increment. On the final reading, the total recovery was found to be $^3/_{16}$ in. The piles easily met the load requirements and came up to our expectations in all respects.

NEW STRUCTURE A STIMULUS TO CIVIC PRIDE

It has proved a fortunate arrangement to combine the municipal building with the tower. Some time before the town of Lake applied to the PWA for a grant to aid in the construction of a water works system, it had applied for one to construct a town hall. That application was never approved. When the town board informed me of this fact, I recommended that a structure be built enclosing the water tower and containing facilities for the town government, on the ground that the centralization of governmental functions in one building to serve as a civic center would be conducive to greater efficiency and would cut down the cost of operation. There was another reason for this recommendation. Although the built-up area of the town, which makes up the water district, had all the characteristics of a small city, the fact that it had so recently developed from a rural area had caused it to lack civic interest and civic pride. It was my belief that the possession of a building characterized by utility and dignity, entirely different from the ordinary town hall, would inspire in the citizenry a spirit of pride and respect for their local government, which the ordinary type of town hall often fails to instill.

Happily the completion of this structure had the desired effect. In fact, when the grand opening was held, 20,000 people went through the building, the great majority of them of course coming from the city of Milwaukee. We wanted to give the community an appreciation of modern things, so we carried the modern motif throughout the design, even in the furniture. Since the new building has been in use, the attitude of the audience has been similar to that which marks court hearings—a vast improvement over the slipshod, undignified proceedings that characterized the former quarters.

Largely, the attractive effect of the structure is produced by the octagonal concrete shell which encloses the steel frame and the lower portion of the elevated tank. The ground floor of the building consists of four 50 by 50-ft quadrants surrounding the tower and built integrally with it. These quadrants house the town offices, water department, softening plant, pump room, garage,



CONSTRUCTION VIEW—CONCRETE FORMS IN PLACE FOR AN UPPER LIFT

health office, public works department, police department, and jail.

The council room, with a seating capacity of 300, occupies a space 60 ft on octagonal diameters on the second floor. A spacious corridor provides easy access to all parts of it. Entrance to and exit from this room is obtained by a double stairway from the main vestibule. There are also stairs at the rear. The third and fourth floors will remain unfinished until the town requires more office space, but the stairways, elevator well, beams, floor slabs, heating and plumbing lines, and electrical conduits for these floors have been built.

VERTICAL LINES INTRODUCED IN THE DESIGN TO EMPHASIZE HEIGHT

Structural plywood, $^3/_4$ in. thick, was used for all the concrete wall forms because the design of the architectural concrete contemplated an absolutely smooth surface which could not be obtained with ordinary lumber. Ordinary forms, if the boards are smooth and of uniform width, can be used to advantage in architectural concrete if the design contemplates horizontal lines. That would involve a different motif from what we have in our design. Desiring to emphasize the height of the tower, we eliminated all horizontal lines as far as esthetics and construction would permit. We emphasized height by means of the pilaster effect and the use of a few vertical lines in the tangent panels.

The structural steel of the tower carries all the loads above the ground floor. In order to keep the cost of the steel down we kept our dead load to a minimum by making the concrete as thin as good engineering would permit. So the walls of the tower above the second floor have a thickness of only 6 in. They are heavily reinforced. Unobtrusive copper expansion joints in the concrete extend around the tower at intervals of about 14 ft. These horizontal joints occur at the bottom of the steel purlins which support each succeeding section of concrete wall. There are also vertical expansion joints at regular intervals.

northwest of the airport at an elevation 140 ft above datum.

This new location required the construction of a bridge over the deep railroad cut separating the site from the

STEEL SUPERSTRUCTURE OF TOWER IN PLACE
Around This Prosaic Skeleton, a Beautiful Building Was Formed

THE COMPLETED TOWER BUILDING—AS SEEN FROM BRIDGE OVER RAILROAD

We desired also to emphasize the mass of the tower. This effect was obtained by stepping out what appear to be columns at the corners of the octagon. This step-out effect was obtained not by thickening the concrete into pilasters, but by building the forms outward, still maintaining a thickness of concrete of about 6 in. Originally it was intended to use a plastic of some sort for facing the forms. But the various form facings with which we experimented in the construction of some of the foundation walls, did not react well to the type of concrete we had designed. One plastic gave a good concrete surface but was so absorbent that after one pouring it became too soft to be usable. Another was so non-absorbent that it caused air pockets to appear in the surface of the concrete. Finally plywood was tried. It was found to leave a surface free of air pockets and other markings except the grain of the wood. These grain marks we removed by rubbing with a carborundum brick.

DESIGN OF CONCRETE MIX FOR EXTERIOR WALLS

It should be emphasized that architectural concrete when properly constructed makes an excellent exterior wall for a building. However, in using this material engineers and architects must exercise great care in the gradation of aggregates, in regulating the water content and maintaining a proper water-cement ratio for high strength, and in selecting material for the face forms. Careful study must be given to expansion joints where the area of the concrete surface is great and where there is a wide variation in temperature such as is found in the North Temperate Zone. In using relatively thin concrete wall panels (6 in. thick or less) over wide openings such as double doorways, expansion joints at the ends of the panels may not entirely eliminate the possibility of cracking even though a conventional amount of reinforcing is used. In panels of such thickness it is bility of slight cracking. In thin panels over such wide openings, small vertical strips can be built on to the face form to localize this slight cracking and to serve as ornamentation.

Prior to the placing of concrete, several trial mixes were made to determine that best suited for the particular construction conditions. The specifications stipulated a minimum cement content of 1.35 bbl per cu yd of concrete and a water cement ratio of 6 gal of water per sack of cement. To produce a high quality, workable concrete, four sizes of aggregate were used, all accurately measured by weight, under constant control. Variations in the moisture content were determined from time to time and corresponding adjustments made on the water-measuring device. Slump tests were made regularly to control the consistency of the concrete.

For the most part the concrete was placed by hand methods, which necessitated workability. Canvas tubes equipped with metal hoppers were an effective means of placing within the narrow spaces between the inner and outer forms. Long-handled spades were used to work the concrete in around the reinforcing steel, with the result that there was very little honeycombing. External vibrators operating on the walers of all wall forms were most helpful in eliminating the possibility of honeycombing. Patching the surface of architectural concrete at any time is objectionable from the standpoint of appearance. A difference in surface color and texture is bound to result and of course the use of neat cement to cover up such defects is a very unsatisfactory remedy.

Forms were removed not sooner than four days after the concrete was placed, after which the exterior surface of the building was cleaned. Fins and small projections were first removed by means of a carborundum stone, and then the surface was wet down thoroughly. The moist surface was given a coating of grout, of a creamy consistency, which was used as a scouring medium. The grout was worked over the surface by means of wood floats and fine stone, a process which cleaned the surface and filled the minute air and water holes so often found when forms are removed. As soon as the grout began to stiffen, it was removed from the surface with a steel trowel. Later the surface was wiped down with a burlap cloth to remove the film of grout from the cleaned surface.

Because of its location at one of the highest points in the town, and its proximity to the Milwaukee County airport, the tower had to be provided with aeronautical lighting on top, 162 ft above grade. In addition to the beacon light, sixteen 200-w red lamps illuminate glass-block windows at the two-thirds point of the tower, and eight 1,000-w lamps are being provided on the second-story roof to floodlight the upper structure.

Exclusive of the elevated steel tank and its supporting members, the concrete structure cost $161,500. This includes the completion of all offices and the necessary heating, plumbing, air conditioning, electrical work, and custom-built furniture. Other costs were as follows: deep well, $26,000; pumping and water-softening equipment, $85,000; reinforced-concrete bridge spanning the North Shore tracks, $45,000; and spur track and electric utility service, $10,000.

The total estimated cost of the project, which was financed by means of a 45% grant and revenue bonds issued by the town board, was $1,300,000, including engineering and interest on construction. The actual cost, including these items as well as utility service and all other miscellaneous contracts, amounted to

ceedings that characterized the former quarters.

Largely, the attractive effect of the structure is produced by the octagonal concrete shell which encloses the

the steel purlins which support each succeeding section of concrete wall. There are also vertical expansion joints at regular intervals.

The Port of New York—Interests of the U.S. Navy

By RALPH WHITMAN

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

REAR ADMIRAL, CIVIL ENGINEER CORPS, U.S. NAVY; PUBLIC WORKS OFFICER, 3D NAVAL DISTRICT, NEW YORK, N.Y.

SHORE facilities, which are indispensable to the proper functioning of naval vessels, are extensive and varied in the New York area. One notable lack, however, is in exclusive pier berthing, and this frequently entails hardship and sometimes embarrassment. All port facilities and engineering construction must contribute to convenience as well as efficiency. In this paper Admiral Whitman stresses principles applicable to the shore facilities of the Navy in general, as well as to this particular locality. His paper was one of a group on the Port of New York, presented before the Waterways Division at the Society's Annual Meeting in New York in January. [The author desires to state that any views expressed in this paper represent his personal opinions and are not to be construed as reflecting the views of the Navy Department or of the Naval service in general.]

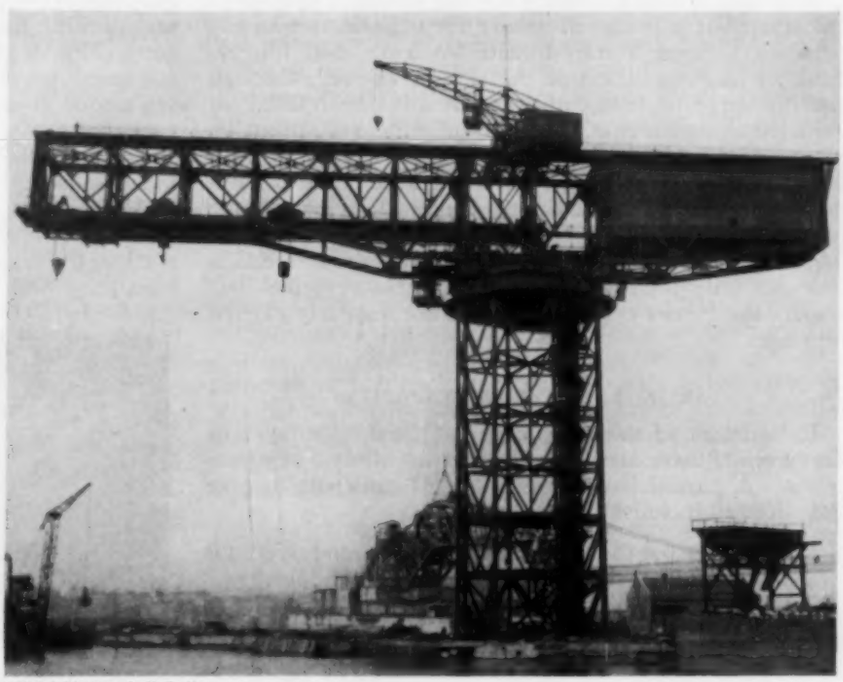
CONSIDERING national before local aspects of naval port problems, some remarks respecting the Navy's interest in ports in general, and its need for shore stations, may be enlightening. That non-existent but ubiquitous person, the average citizen, thinks of naval activities as being purely at sea. Why, he may ask, is the Navy concerned with matters on land?

The answer is that man is essentially a land animal; he cannot sustain himself for long without contact or communication with land. While the Navy is composed of seafaring men and its ships are designed for keeping the sea, it is nevertheless true that neither ships nor men can stay indefinitely out of touch with land. In naval parlance, they are necessarily "shore based."

To come down to cases, it may be said in general terms that every naval craft, whether surface vessel, submarine, or aircraft, depends absolutely for its continued maintenance upon facilities that can exist only on land; and roughly speaking the time during which any craft can remain away from its sustaining shore facilities is in proportion to the size of the craft. Thus it is physically possible for a battleship, aircraft carrier, or similar large vessel to keep the sea for well over a year, assuming means for replenishing fuel, certain foods, and other consumable supplies that can be delivered to it without necessitating its return to port. This is because of its large personnel skilled in various trades, its considerable facilities for making its own repairs to mechanical equipment, its storage space for spare parts and repair materials as well as for food, its medical department with special quarters for the sick, and its relatively liberal living space for personnel.

However, as a practical operating matter it is important for such a ship to visit a dry-dock at shorter intervals for the removal of marine growths that otherwise would lessen her speed and reduce her steaming radius beyond tolerable limits. For military vessels it is only those in combatant condition that count. After a certain period of time, the capital ship must visit a navy yard for accumulated repairs and for of her own force or that of a repair ship.

Large cruisers have sea-keeping abilities approximating, but not quite equaling, those of a battleship. Destroyers with their intricate and high-speed machinery, their less rugged construction, and their much more restricted space for personnel, shop facilities and stores, have still less sea-keeping endurance; and submarines have less than destroyers. In the case of submarines there is hardly space for more than pure operation, and practically none for mechanical upkeep work. In addition, limitations of space entail limitations on the diet of the crew. In the larger submarines it is possible in a temperate climate for the personnel to tolerate for considerable periods the restricted living conditions that necessarily prevail, but in the tropics or in very cold climates relief from these conditions is needed to maintain physical and mental health. This is true of small submarines everywhere. Even with the highest degree of initial fortitude human stamina has its limitations.



Official Photograph, U.S. Navy

HAMMERHEAD CRANE, BROOKLYN NAVY YARD, COMPLETED IN 1940

the panels may not entirely eliminate the possibility of cracking even though a conventional amount of reinforcing is used. In panels of such thickness it is difficult at times to get enough reinforcing steel in the concrete with sufficient coverage to eliminate the possi-

engineering and interest on construction. The actual cost, including these items as well as utility service and all other miscellaneous contracts, amounted to $1,325,000. Acting for the town, the writer had charge of design and construction.

Official Photograph, U.S. Navy

INCINERATOR, BROOKLYN NAVY YARD, TO HANDLE 76 TONS OF REFUSE PER 24 HOURS
Completed in 1939, at a Cost of About One-Quarter Million Dollars

Even greater limitations apply to aircraft. They are the least self-sustaining of all. Practically speaking they are "on their own" only while in the air, and this is merely a matter of hours.

In order not to overdraw the picture, it is proper to say that such sea-going units as fleet repair ships (which are essentially floating workshops), destroyer tenders, submarine tenders, and aircraft tenders supplement in important measure the maintenance facilities possessed by the various classes of craft themselves. But these auxiliaries too have their limitations both as to their ability to take care of their charges and as to their capacity for self-maintenance. Sooner or later all must come to land for restoration and continuance of their ability to function.

Not only is this necessary for the material upkeep of the craft, but it is also necessary for maintenance of the personnel, through refreshment by leave and liberty, through hospitalization of the sick or injured, through the discharge of time-expired men and the refilling of depleted complements, and through the redistribution of men among ships of other classes and on other stations to produce a well-developed and versatile naval personnel. Training is one of the most important peace-time functions of the Navy. In aviation, much of the training can be carried on only from shore bases, and this is true not only for seaplanes and other large types, but also for the carrier-type planes that are regularly carried on ships.

PARTIAL LIST OF SHORE FACILITIES

In addition to shore facilities for the maintenance of Navy craft, there are shore stations for other Navy purposes. A partial list, incomplete but sufficient to give the picture, includes the following:

Navy yards, for the periodic dry-docking and overhaul of vessels and for the construction of new ones.

Submarine and destroyer bases, for training and operation.

Training stations, for the preliminary training of recruits before they are sent to sea.

Air stations and air bases for the advanced tactical training of aviation personnel and for the upkeep of aircraft.

Supply depots, for the warehousing of supplies following purchase in quantity, and for issue to units of the fleet in smaller quantities; also for the storage of reasonable reserve stocks.

Fuel depots, for the receipt, storage, and issue of fuel oil, lubricants, gasoline, and so forth.

Ammunition depots, for the storage, preparation for use, and issue of ammunition, pyrotechnics, and other explosives.

Hospitals.

Operating bases, for the intermittent sojourn and provisioning of ships not requiring navy-yard work.

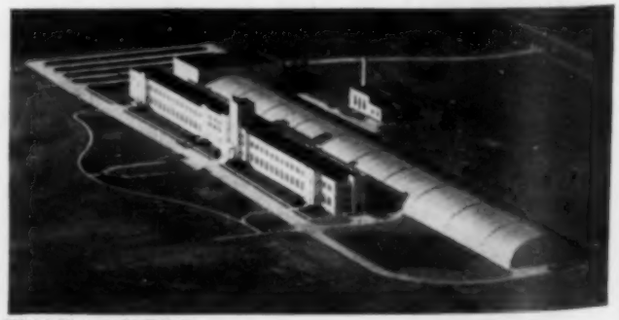
Anchorages and pier berthing for vessels of the fleet in protected waters near sources of supply, railroad connections, and centers of population.

Marine barracks for home base and training of marines.

Radio stations, some of high power for long-distance communications, some of moderate power for local communications, and some of special type for radio-compass service to naval and merchant ships of all classes and nationalities at sea.

Special type stations for numerous special purposes, such as the U.S. Naval Academy, Naval War College, Naval Observatory; measured-mile courses at various locations for determining and calibrating the tactical characteristics of ships; armories for training Naval Reserve units; the Navy Department, Washington, housing administrative and high command headquarters; Naval District administrative headquarters in a dozen or so places in the continental United States, in Hawaii, in the Philippines, and elsewhere; and miscellaneous other activities in various places.

For some of these activities the geographic location is not of controlling importance, provided it is accessible and that physical conditions are suitable. Other activities must be specially and properly located geographically for strategic reasons. For example, repair and docking facilities for ships must be located so as to serve ships in given strategic areas without necessitating too much travel for them to and from their stations at sea under given military conditions. Too great a distance from base reduces the number of effective ships at sea, because of the length of time each ship in its turn must be absent for necessary overhaul and repairs. In addition there is the important element of fuel consumption entailed by unproductive travel from sea station to shore base and return. A properly located base may well be the equivalent of one or more ships.



Official Photograph, U.S. Navy

NEW DAVID W. TAYLOR MODEL BASIN, CARDEROCK, MD.

that count. After a certain period of time, the capital ship must visit a navy yard for accumulated repairs and for conditioning work beyond the capacity

Official Photograph, U.S. Navy

HAMMERHEAD CRANE, BROOKLYN NAVY YARD, COMPLETED IN 1940
Capacity, 350 Tons, at 115-Ft Radius; Cost, Three-Quarter Million Dollars

so far as the effectiveness of a division of the fleet is concerned.

With this background we may note the application of the various factors to the Port of New York. Bordering on the navigational waters of this region, or within easy

Official Photograph, U.S. Navy

U.S. NAVAL ACADEMY, ANNAPOLIS, MD.

reach of them, and dependent upon ready access to and from the sea are the following Naval properties, facilities, and activities:

Navy Yard, Brooklyn
Naval Hospital, Brooklyn
Naval Medical Supply Depot, Brooklyn
Naval Ordnance Plant, Baldwin, Long Island
Naval Ammunition Depot, Iona Island, N.Y.
Naval Ammunition Depot, Lake Denmark, Dover, N.J.
Naval Reserve Aviation Base, Floyd Bennett Field, Brooklyn
Naval anchorages in the North River off upper Manhattan and elsewhere in New York Harbor
Naval Branch Hydrographic Office, New York City
Various Reserve armories, recruiting stations, the Third Naval District Headquarters in New York City, and miscellaneous other naval activities.

Probably the most prominent of all these items in the public mind is the Navy Yard at Brooklyn. To this yard go surface craft of all classes for dry-docking, overhaul, and repair. The yard is also equipped to build vessels including capital ships. Established in 1800, its development has paralleled the development in ship construction and it is a well-equipped establishment. It has upwards of 200 buildings, some large, many small, but all useful; four dry-docks and two ship-building ways. It is at present employing over 10,000 men, including those on the construction of new vessels. Exact figures are not at hand, but it may be said that fixed construction, machinery and tools, aside from the more than 200 acres of land, represent a replacement value probably of the order of $100,000,000.

The Naval Hospital, near the Navy Yard, was established for the restoration to duty of those who have recovered from disabilities. It has facilities for the surgical and medical treatment of Navy personnel and is staffed by officers of the Medical Corps of the Navy with enlisted male nurses (hospital corpsmen), and with female nurses regularly inducted into the Naval service and forming a permanent part of it.

The Naval Medical Supply Depot is one of several suitably located in various parts of the country. It is concerned with the procurement and storage of medicines, of medical, surgical, and dental supplies, of hospital and dispensary furnishings and equipment, and with the issue of these items to the fleet and to Naval medical units on shore.

The Naval Supply Base and Naval Clothing Depot are located in South Brooklyn near the Bush Terminal. The Supply base was established in 1918 and served an important function during the World War. It has about 10 acres of land, a number of buildings, and a replacement value of several tens of millions of dollars. As its title indicates, its normal function is in connection with the procurement, storage, and issue of materials used by the Navy, involving considerable quantities of many thousands of items of very diverse character. As a supply base it is not very active at the present time but its potential importance is great.

The Naval Ammunition Depot, Iona Island, is on the west bank of the Hudson River a short distance below West Point. The river is navigable for ships of considerable size from the sea to Iona Island and above. The depot affords storage for ammunition, prepares it for issue, and issues it to the fleet. It also provides temporary storage for the contents of magazines of ships going to the Navy Yard for overhaul and repairs. The necessity for removing explosives from such ships is obvious.

Among the Navy anchorages in the vicinity of New York is the North River anchorage from about 60th Street to the northerly limit of Manhattan. Ships in commission anchor here in the course of their routine duties when shore berthing is not available. The area provides smooth-water anchorage convenient for the visiting public, for shore liberty for crews, and accessible for the delivery on board of meats and other fresh provisions. It is an important adjunct to the fleet's activities in North and Middle Atlantic waters.

NEED FOR BERTHING FACILITIES IN NEW YORK HARBOR

The Navy has no pier berthing of its own in New York Harbor except at the Navy Yard. It needs such facilities badly. Within the past year the Navy Department has sent ships to New York in connection with their normally assigned duties and also in response to pressing local requests, and the local Naval authorities have

operation.

Training stations, for the preliminary training of recruits before they are sent to sea.

Air stations, for the initial training of aviation personnel.

Official Photograph, U.S. Navy

NEW DAVID W. TAYLOR MODEL BASIN, CARDEROCK, MD.

In the Longer Building, Ship Models Are Towed for Naval Architectural Design Data

New York, having charge of the city-owned waterfront, was most cooperative in efforts to solve the problem. Too much cannot be said in appreciation of its effective help. But its ability was limited by the city's own need for waterfront berthing and by the leases of other city-owned waterfront to commercial maritime interests. In addition to the Navy's own disadvantage, more than

Official Photograph, U.S. Navy

BARRACKS BUILDING, MARINE BARRACKS, QUANTICO, VA.

one embarrassing situation has arisen when naval vessels of foreign nations have come to this port on visits of international courtesy and have had to be given accommodations of the most indifferent kind—and even these with difficulty.

A problem that may occasionally develop in connection with navigational channels, anchorages, and berthing results from the filling in of low-lying riparian lands or submerged areas closely adjacent. The filling of such soft land may push a "mud wave" out into the offshore waters, shoaling them to such an extent as practically to destroy their usefulness for anchorage.

Lest anyone should regard this as the far-fetched imagining of an unduly apprehensive mind, I hasten to recall a very concrete and exceedingly awkward instance. In that case the filling was done by a local civic agency quite unconnected with the Navy, and undoubtedly it was done with no thought of the consequences. The harmful results, though not foreseen, were none the less real and became distressingly apparent to those charged with finding anchorage space in the locality. Anchorage berths for a number of naval vessels were, for the time being at least, destroyed unobtrusively and without notice—an instructive example of how engineering and civic enterprise in one direction may lead to untoward results in another.

This is a lesson for all to take to heart. Had the anchorage been used for merchant vessels the physical results would have been similar but the economic interests of the port would have been more directly affected. In a port like New York, where convenient berthing space is by no means going begging even in this period of slackened shipping activity, it concerns not only the Navy but also all those interested in the economic welfare of the community to see that potential shipping waterfront be not destroyed or diverted to other purposes without due weighing of the comparative benefits. The organic character of our present-day civilization calls for mutual adjustment of conflicting plans for improvements.

Such comments as have been given regarding the Navy's activities illustrate the importance of the Port of New York to the naval defense of the country. A

the merchant marine. The Navy is concerned with the merchant marine in many ways; in fact, the interests of the two run parallel. Railroad sea terminals support the merchant marine, and they are also of transcendant importance to the Navy in certain cases.

It is obvious that to the Navy unobstructed navigation channels from the sea to its waterfront shore stations are vital. The maintenance of adequate channel widths and depths is essential. Depths to the dry-docks of a navy yard must be sufficient not only for ships at normal draft but also for those requiring abnormal draft because of their damaged condition.

Also, navigation channels should not be unduly obstructed by bridges. The Navy takes a lively and necessary interest in any proposals for bridges across the sea approaches to its shore stations. This does not mean that the Navy maintains a dog-in-the-manger attitude toward communities initiating proposals for such bridges. But the Navy would be derelict in its duty if it failed to point out the objectionable features of any project under consideration. In the case of large bridges across channels connecting important Naval stations with the sea, sufficient headroom above high water and sufficient lateral clearance between bridge piers for the channel span are essential. Also, it is highly desirable, and in some cases vitally important, that the channel span be of a type, and the channel itself of a depth, to insure that any wreck of the channel span will not obstruct the channel.

The Golden Gate Bridge at San Francisco well illustrates how the interests of the community and of the traveling public with respect to a bridge can be reconciled with the national interest in maintaining access between port and sea for vessels of any present or prospective size and under any condition of the bridge resulting from enemy attack, major sabotage, or a cataclysm of nature such as a hurricane or an earthquake. In that case adequate overhead clearance was provided for vessels of any mast-head height. The horizontal clearance between the 3-fathom curves on each side of the channel was not diminished. The natural depth of the channel is so great, and the suspension span across it is so flexible, that even in the unlikely event of the span's complete collapse it would fall into water deep enough to submerge it far below the draft of any vessel.

In this case, as is usual, the various factors affecting naval and maritime interests were presented to the Army Engineer Board at its hearings on the matter and those desiring to have the bridge built also presented their views. The accommodation of all these interests resulted in the general design that was adopted. It is believed that the decision was acceptable to all parties. The case is a good example of how such things can be handled.

In such cases and also in cases where the Navy's plans for its own waterfront construction and dredging impinge on the jurisdiction and function of the Army Engineers in preserving general navigation interests, the Navy approaches the Engineer Department just as would a private individual, a municipality, or other civic body. The law requires this and the Navy observes the requirement willingly and accepts the rulings cheerfully even when they are adverse, as sometimes happens. Obviously the settlement of such things often involves an adjustment of conflicting considerations.

The particular application of this paper is to the Port of New York but the basic considerations clearly apply to any port. The aim in this short recital has been to

more than 200 acres of land, represent a replacement value probably of the order of $100,000,000.

The Naval Hospital, near the Navy Yard, was established in 1832. Its location is convenient for the transfer of the sick from ships coming to the Navy Yard, and for has sent ships to New York in connection with their normally assigned duties and also in response to pressing local requests, and the local Naval authorities have found themselves unable to find berthing space for them at piers. The Department of Docks of the City of

Planning the Pennsylvania Turnpike

Development of General Program, Policies, and Economics

FROM A PAPER PRESENTED BEFORE THE PHILADELPHIA SECTION

By SAMUEL W. MARSHALL

CHIEF ENGINEER, PENNSYLVANIA TURNPIKE COMMISSION, HARRISBURG, PA.

SELDOM are large projects confronted with the economic difficulties or the construction problems that beset the Pennsylvania Turnpike, now nearing completion. The engineering features of this modern trunk line were covered in the February and March issues. Mr. Marshall here describes the efforts made to justify the financing of over $65,000,000 worth of work and then the putting of this immense sum under contract within nine months. It will be readily understood why he takes such pride in this feat performed by his organization of 1,100 engineers.

TO give a true and accurate picture of the conception, organization, design, and construction of the Pennsylvania Turnpike, it is necessary to go back to June 1937, when George H. Earle, then governor of Pennsylvania, appointed the men who comprise the Pennsylvania Turnpike Commission. The Act of Assembly which created the Commission was an excellent and forward-looking piece of legislation, but in its preparation one salient feature was either overlooked or purposely omitted, that is, the appropriation of any money to provide for its functioning. It is true the Act provided that the State Department of Highways might advance funds for engineering purposes only, but the strictest interpretation of "engineering purposes only" was insisted upon by the offices of the Attorney General.

At that time I was serving as chief engineer of the Pennsylvania Department of Highways and was charged with the duty of making a careful scrutiny of any and all funds expended by the Department for engineering, research, and personnel for the Turnpike. The engineers who were working on the engineering features of the Turnpike were assigned to the various district offices of the State Highway Department and were operating under the jurisdiction of the Department's district engineers. Feeling that the best results were not being obtained in this manner I created, within the Department of Highways, an organization known as the "Turnpike Division" and established field offices, with central offices in Harrisburg.

The Commission's earliest action was to engage consulting engineers on the design, including ventilation of the several tunnels that had been partially driven by the old South Penn Railroad; and the making of a comprehensive independent traffic survey and report as to the character and amount of traffic that might be expected to use this highway. Simultaneously with the preparation of the traffic report, the Pennsylvania Department of Highways prepared a comprehensive and detailed estimate as to the cost of a safe, four-lane, high-speed highway across the southwestern part of Pennsylvania.

It is of paramount importance to note that when the estimate of the total cost of the Turnpike was being prepared by the Department of Highways, the definite engineering standards that were eventually to be incorporated in this great road were not yet set up. Briefly, the estimate was prepared on the basis of four 11-ft

ble type of bituminous surface—with a 10-ft medial strip and 10-ft shoulders. Likewise the structures carrying the Turnpike were calculated on the basis of a 44-ft roadway, and it was anticipated that a great part of the intersecting roads would be abandoned or relocated in order to keep the number of structures along the line of the Turnpike to a minimum. In fact, we calculated that 97 structures would carry the Turnpike across intersecting roads. In this early period of preparation of estimates, after a discussion with automotive manufacturers, a study of the rugged terrain through which the highway must pass, and a balancing of economics, a maximum grade of 3% and a maximum curvature of 6° were determined upon. There were to be no intersections at grade, and eight tunnels were to be utilized to pierce the intercepting mountains of the Appalachian range.

From actual surveys, cross sections, and the generous use of United States topographical survey maps, excavation quantities were estimated at 20,000,000 cu yd, which afterwards proved to be remarkably accurate. The figures presented to the Turnpike Commission by the Department of Highways indicated a total cost of approximately $44,000,000, to which necessarily was added an estimated amount for land acquisition, legal and administrative work, engineering, bond discount, and interest during construction. Further, it was proposed to the Commission that three years be allowed for the completion of the Turnpike in accordance with the foregoing estimate.

Concurrent with the submission of the cost estimate, the consultants' report of the estimated traffic and its

RELIEF MAP OF PENNSYLVANIA SHOWING TURNPIKE ROUTE THROUGH THE ALLEGHENIES

Such comments as have been given regarding the Navy's activities illustrate the importance of the Port of New York to the naval defense of the country. A corollary matter, also of importance to the Navy, is the development and maintenance of port facilities for

The particular application of this paper is to the Port of New York but the basic considerations clearly apply to any port. The aim in this short recital has been to make clear the importance of the Port of New York to the naval defense of the nation.

probable earnings was submitted. When a review of these data had indicated that the Turnpike was an entirely feasible financial proposition, the Commission immediately approached banking interests on the sale and purchase of Turnpike bonds.

PRIVATE FINANCING FOUND IMPRACTICAL

After extensive negotiations for the sale of $61,000,000 worth of such bonds to private bankers, it was found impractical to finance the entire cost of the Turnpike through these channels. The Commission next applied to the federal government for aid and received a WPA allocation of approximately $24,000,000 worth of labor. With this as a back-log, negotiations were again entered into with the bankers, but without success.

When additional funds were allocated to the PWA by the 1938 session of Congress, application was made to it for a 45% grant, and at the same time a request to the RFC to purchase $35,000,000 worth of Turnpike Commission bonds. These two federal agencies agreed, and in the latter part of June 1938 definite commitments were made. Legal steps were immediately initiated by both the PWA and the RFC for the completion of the transaction. All documents were signed on October 10, 1938, and for the first time since the Pennsylvania Turnpike Commission came into existence, it had funds of its own.

During the preliminary stages of the design extreme care had to be exercised in expending Highway Department funds which, under the Act, were to be repaid by the Commission from the sale of bonds. As a result, when the Grant Agreement and the Trust Indenture were signed by the Commission and the Secretary of Highways, the engineering, administrative, and legal staff of the Commission comprised approximately 160 men. Not a single construction plan had been made, yet four days later, on October 14, 1938, a section in Cumberland County, ten miles in length, was advertised for bids for grading and drainage; and construction under contract was started on October 27. The design period of the Pennsylvania Turnpike had now begun.

It is important to bear in mind the factors that controlled the construction of the Turnpike, its structures and tunnels throughout:

1. The entire 160 miles of the Turnpike had to be completed on May 1, 1940; this date was subsequently moved along to June 28, 1940.
2. A very definite amount of money—$61,000,000—was all that was available for constructing, financing, and putting the Turnpike into paying operation.
3. The Act definitely fixed the termini, that is, Middlesex in Cumberland County and Irwin in Westmoreland County.
4. Grades were limited to not more than 3%, curves to not exceeding 6°. The alinement was controlled by the two termini and the 16 tunnel portals.
5. No existing state highways or township roads could be utilized.

When this active stage in the construction of the Turnpike had been reached, a dream road had become an actuality—its tempo and importance began to increase by leaps and bounds. Prior to the government financing, scarcely any one had paid the slightest attention to the engineering work that had been, and was being carried out by the Turnpike engineering staff; but as soon as the financing was completed we were besieged with offers of aid and suggestions for design, methods, and procedure—all proffered without a proper understanding of the antecedent facts. Keeping in mind the conditions under which the original estimate

CONCRETE PAVING OPERATIONS IN THE MOUNTAINS

was made, before thought was given to the possibility of federal financing, a startling fact intrudes, the realization that the completion time had been cut from 36 to 21 months—a serious reduction.

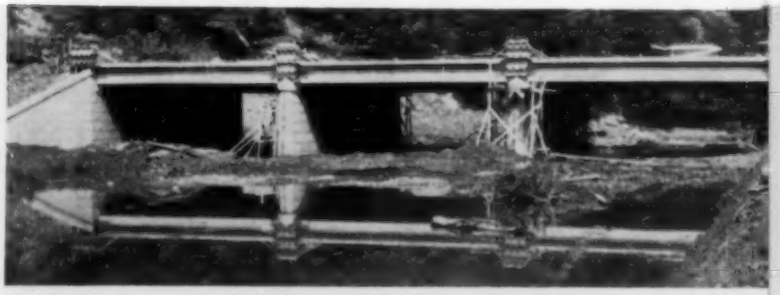
The engineering staff of the Pennsylvania Turnpike Commission in October 1938 was made up of a few individuals trained in highway work and procedure but without any definite organization or specifically assigned duties. Perhaps they numbered 115. One year later the organization comprised over 1,100 trained men and women. It was, in my opinion, the fastest moving, hardest hitting engineering organization with which I have ever been associated.

ENGINEERING RECORDS BELIEVED BROKEN

Let me briefly outline the accomplishments which I feel certain have broken all engineering records. Work was started on the plans for the Turnpike on October 10, 1938, and on July 7, 1939—nine months later—the entire road, 160 miles in length, including seven tunnels and 300 structures (some quite major in character), had been advertised for bids and was under contract. Standards had been developed that far exceeded those originally contemplated. The roadway width had been increased from four 11-ft lanes to four 12-ft lanes—all of concrete, rather than two of concrete and two of flexible bituminous surface as originally planned. Structures carrying the Turnpike, with the exception of three which involved major construction or viaducts, were extended to full roadway width, and the center piers of structures crossing the Turnpike overhead had been eliminated in so far as economically possible. The number of the structures originally contemplated had increased from approximately 180 to 308.

Last of all, but certainly not the least—approving agencies had entered the engineering picture. Included among these were the Pennsylvania Department of Highways, the PWA, the RFC, consulting engineers for the financial interests that had purchased $10,000,000 worth of bonds from the RFC, the Pennsylvania Depart-

RELIEF MAP OF PENNSYLVANIA SHOWING TURNPIKE ROUTE THROUGH THE ALLEGHENIES
Of the Seven Tunnels, Two Are Close Together near the East End



TYPE OF CONCRETE STRUCTURE, T-BEAM BRIDGE, WITH THREE SPANS OF 45 FT, CROSSING BRANCH OF JUNIATA RIVER

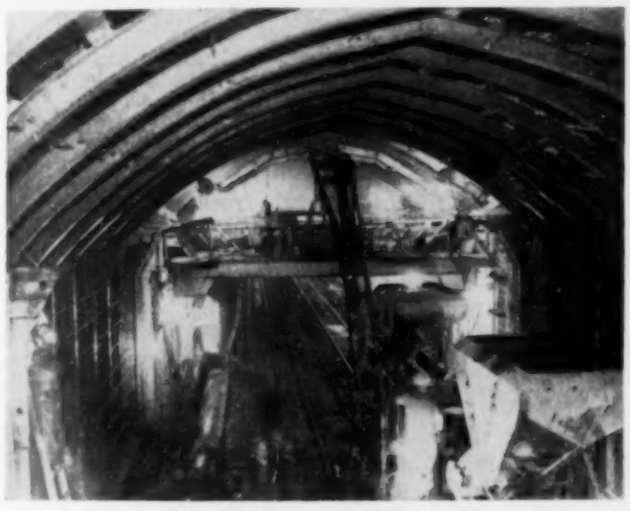
were not yet set up. Briefly, the estimate was prepared on the basis of four 11-ft lanes—two of concrete and two of a flexi-

ment of Labor and Industry, the Pennsylvania Department of Health, and the Pennsylvania Art Commission. Engineers who have had experience in obtaining the approval of such state and federal agencies will understand in a measure the terrific complications that beset our engineering personnel.

By a simple process of arithmetic it becomes clear that the engineering staff of the Commission (1) produced and advertised for bids an average of 4.8 miles of grading and drainage plans per week (during the period from April 1 to July 1, 1939, this rose to 7.7 miles); and (2) developed plans and specifications for seven tunnels, the last of which was advertised on April 21, 1939, and for 308 structures—an average of 8 per week.

Early in August 1939, when the last mile of Turnpike had been placed under construction, we stepped into what I call our second phase—the construction period. We had set for ourselves, in our contract documents, a tempo of construction that has not, I believe, been equaled in the engineering world today. We specified equipment which in total amounted to over $12,000,000 in replacement value; we insisted that contractors work two and three shifts a day; and we manned each and every contract with a trained personnel of resident engineers and inspectors.

Many engineers, equipment manufacturers, and contractors approached me personally and told me in great confidence that the thing could not be done—weather conditions would be bad, equipment would not operate continuously for 24 hours a day, labor could not be



PUMPING CONCRETE INTO ARCH FORMS OF TUNNEL
Steel Ribs, as Shown, Were Used Where Rock Conditions Were Unfavorable

secured, the Commission could not man its construction with the proper personnel. In fact, every possible reason was advanced as to why the schedule could not be maintained. However, it was maintained, and as the 1940 construction season opens, we are abreast of what, a year ago, was termed an "impossible schedule." Such accomplishments could not possibly have been obtained were it not for the wholehearted and thorough cooperation of every member of the Commission personnel and the "will to do" on the part of some very excellently equipped and trained contractors. Needless to say, we have encountered difficulties; we have had to change our plans and make adjustments here and there; but one instruction I received from the Commission has stood unchanged, that "nothing shall be permitted to stop the work." Such has been our slogan throughout, and it just has not stopped.

Considering the tremendous pressure placed upon our engineering staff, it is perfectly logical to assume that some time in the future criticism will be leveled at comparatively unimportant features or conditions that have developed or will develop. But, speaking conservatively, the mistakes made either in engineering, design, or construction have been astoundingly few, and none were so serious that they could not be, and have not been, corrected—a glowing tribute, indeed, to a remarkable group of young engineers.

SOME CONSIDERATIONS OF COST

It is with something of a feeling of surprise that I analyze the cost status of the Turnpike as it is being constructed and as it was conceived three years ago. A review of the earlier figures indicates that a remarkable degree of accuracy was attained throughout in so far as construction costs are involved. It is true that an additional grant of $8,500,000 by the PWA and RFC became necessary to insure a complete operating highway. In a measure this additional money was required for the following unforeseen items: (1) unexpected right-of-way costs, (2) required speed of the project, occasioned by federal law, (3) equipment requirements placed in our contract documents, (4) changing from a dual-type paving to all-concrete, (5) lack of sufficient time to procure relocations and vacations of township roads resulting in a serious increase in the number of roadway structures, and (6) the effect of European war conditions.

Acquisition of 160 miles of right of way across a state like Pennsylvania is a feature worthy of comment. In advance one could hardly conceive of the terrific efforts that had to be made and the personal and legal entanglements that had to be straightened out before construction could start on our own land. The Commission paid $2,000,000 to the Pennsylvania and the Baltimore and Ohio railroads for the Old South Penn right of way in order to acquire the tunnels necessary to maintain our grade limitations. Actually we are using only about 40 miles of the original 220-mile right of way.

Incorporated in the Pennsylvania Turnpike are all the modern features that could be worked out or thought of for the comfort and safety of the traveling public. In addition to grades and curvatures, mention should be made of the uniform speed design adopted and adhered to throughout. This standardization of super-elevations and spirals will, we feel, enable motorists to attain a high speed with a maximum of safety. The seven tunnels will be concrete lined throughout, and amply lighted. Ingress to and egress from the Turnpike will be accomplished without interrupting the normal flow of the high-speed traffic. There are no intersections at grade, and a motorist entering the Turnpike at any of its interchanges need not stop until he reaches his destination.

Any engineer would be proud indeed to have contributed to the work of such an engineering organization, whose accomplishments to date rate it second to none.

Highways, the PWA, the RFC, consulting engineers for the financial interests that had purchased $10,000,000 worth of bonds from the RFC, the Pennsylvania Depart-

GIANT STRUCTURES DWARFED MEN AND MACHINERY
Completed Fill at This Site Is 100 Ft High

Design of Hiwassee Dam—Basic Considerations

By CECIL E. PEARCE

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PROJECT DESIGN ENGINEER, HIWASSEE DAM, KNOXVILLE, TENN.

IN the very southwest corner of North Carolina is Hiwassee Dam, a straight gravity structure over 300 ft high and almost 1,300 ft at the crest, now nearing completion. On a tributary of the Tennessee up in the Great Smokies, it provides river storage for the Tennessee Valley, as well as power. By making special provisions for foundation drainage and grouting, it proved feasible to dispense with a cutoff. Based on hydraulic studies, the spillway was given a capacity of 130,000-cu ft per sec, supplemented by sluices that provide an additional 20,000 cu ft. Features of general structural and hydraulic design are here described by Mr. Pearce, who will deal with the project in greater detail in a paper to be published later.

HIWASSEE Dam, now under construction, is in the westernmost corner of North Carolina. It takes its name from the Hiwassee River on which it is located 75.8 miles above the confluence with the Tennessee. Norris Dam on the Clinch River and Hiwassee Dam on the Hiwassee River are the two tributary river storage dams that are part of the Tennessee Valley Authority's program of developing the Tennessee River. Norris Dam, with its installed capacity of 101,000 kw, was completed in 1937. Hiwassee Dam will have an installed capacity of 58,000 kw. The relative locations of these and other Tennessee Valley Authority projects are shown in the accompanying map, Fig. 1.

In brief, the dam is a straight gravity structure 307.5 ft high and 1,285 ft long at the crest (Fig. 2). It has an overflow spillway, controlled by Tainter gates, and four 102-in. regulating conduits, controlled by ring-seal, ring-follower type gates. Provision is made for installing two power units, though but one of 58,000 kw is being included at present. The power plant is of the outdoor or open-deck type.

No provision was made for earthquake forces in the design of Hiwassee Dam. Concerning this feature, a board of consulting geologists consisting of Charles P. Berkey, M. Am. Soc. C.E., L. C. Glenn, and Warren J. Mead, Affiliate Am. Soc. C.E., made the following report:

"This region is a part of the Southern Appalachians, which was uplifted, folded, faulted, and overthrust in complete fashion in mid-geologic time. It was later worn down and again uplifted. The last episode of uplift occurred many millions of years ago. Since then the region has been quiescent." And "the region has long since had its major stresses relieved and all hazard of major earthquakes is believed to have disappeared." The board came to the conclusion that "the factor of stresses due to earthquake vibrations may be omitted in designing dams in the upper portion of the drainage area of the Tennessee River."

Although the dam was designed on a rather conservative uplift assumption, drainage and grouting of the foundations were provided. The general system was to put the drains on the contraction joints, which were generally 50 ft apart, and then to space five other drains between joints. This provides drains at intervals of 8 ft 4 in. Where the contraction joints have special spacings, the distance between drains was maintained at 7 to 8 ft. The holes were drilled to different depths, varying from 20 ft on the abutments to 100 ft in the river section.

SOME DESIGN FIGURES USED IN ANALYZING STRESSES IN THE HIWASSEE DAM

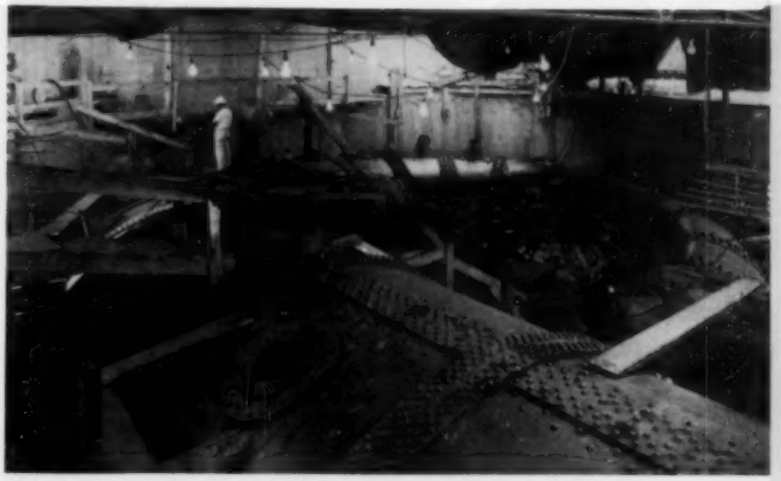
The principal design data used in analyzing the stresses in the dam were as follows: density of water, 62.5 lb per cu ft; density of concrete, 154 lb per cu ft; uplift, varying from 100% of the hydrostatic head at the upstream face to 50% at the line of drains, and to zero per cent or tailwater at the downstream face, all acting over $66^2/_3$% of the area. The stresses were computed for the following load conditions: (a) reservoir water surface at El. 1,532 (normal high water for an assumed discharge of 150,000 cu ft per sec); (b) reservoir water surface at El. 1,537.5 (roadway elevation); (c) reservoir empty. Vertical stresses, principal stresses at the faces, and sliding factors were computed. The maximum and minimum principal stresses were 344.1 and 0.7 lb per sq in., respectively. The maximum sliding factor was 0.638.

Drain holes 5 in. in diameter were sunk by means of the 5-in. shot-drill outfit previously used at the Norris Dam project, though holes somewhat smaller, down to 2 in., might have sufficed. It was thought, however, that the larger holes would be less likely to clog. Drain holes in the foundations were placed in a line parallel to the axis of the dam, 8 to 12 ft downstream from it; they discharge into the lowest inspection gallery available.

Foundations were treated by two general methods—curtain grouting, or a line of grout holes near the upstream face of the dam; and blanket grouting, or general grouting over the

one instruction I received from the Commission has stood unchanged, that "nothing shall be permitted to stop the

tribuited to the work of such an engineering organization, whose accomplishments to date rate it second to none.



RIVETING SCROLL CASE

tion. For the curtain grouting, all the holes were spaced on 5 ft centers on a single line upstream from the drain holes near the upstream face of the dam, as shown on the sections, except that in most of the blocks in the spillway section an extra hole was drilled between each regular hole, making the spacing there 2 ft 6 in.

Blanket grouting followed no particular pattern, but the holes—varying from 5 to 40 ft in depth—were spotted where needed to reach all seams, joints, faults, and cracks. Most of the holes were drilled either along the dip of the joints or at an angle to intercept the joints about 15 ft below the excavated surface of the rock.

Space permits of a description of only a few of the important features of the grouting. All holes were washed, and water-pressure tests made. Records of the tests were kept and used as a guide in grouting. Before grouting, uplift or deformation gages were set to detect any lifting of the foundation. A grout pressure was secured at the bottom of the hole equivalent to 100 lb per sq in. greater than the hydrostatic water pressure at that point, taking into account the weight of the grout in the hole. Grouting consistencies were varied to suit conditions, a water-cement ratio of 2 being the one most commonly used, although ratios varying from 0.5 to 3.0 were also used. Every hole was grouted to refusal, and the pressure held for 15 minutes.

AN INTERESTING FOUNDATION PROBLEM

One foundation condition encountered at Hiwassee Dam was of special interest. A soft seam varying from a few inches to 2 or 3 ft in thickness was encountered in the river-bed excavation near the left bank, dipping with a low angle toward the right bank. Excavating down through this seam in the draft tube and tailrace area, which was excavated first, caused no difficulty, but as the work progressed toward the right bank, the rock overburden became thicker. At the left spillway wall (looking downstream), the overburden was probably 30 to 40 ft thick and except for the seam was excellent foundation rock. Consequently it was decided to wash

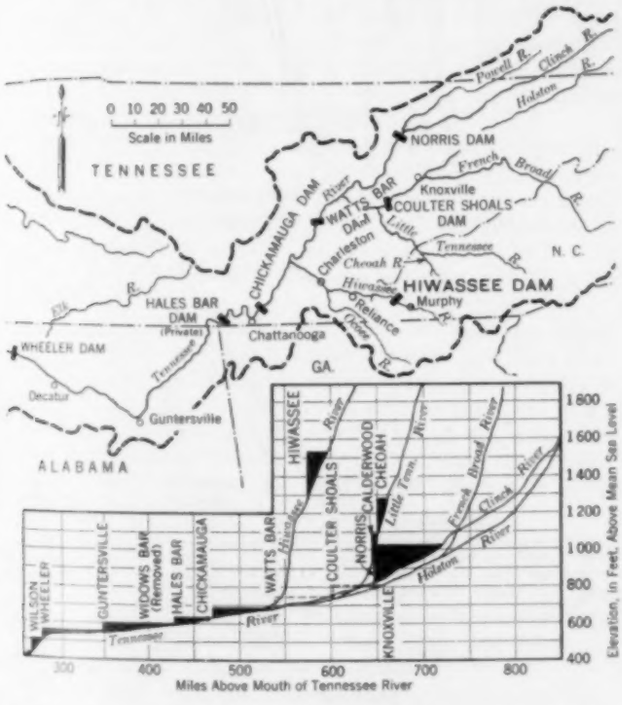


FIG. 1. PART OF THE TENNESSEE VALLEY, SHOWING LOCATION

out the seam and fill it with concrete. Where the edge was exposed in the cut at the left spillway wall, the material was hosed out for a small area and then backfilled with concrete, after which another such area was treated likewise. Further over in the river from the left spillway wall, 36-in. rock cores were drilled down to the seam, which was then cleaned out and concreted through these cored holes, a small section being taken at a time. There were 11 such large core holes, and the area cleaned out was about 2,500 sq ft.

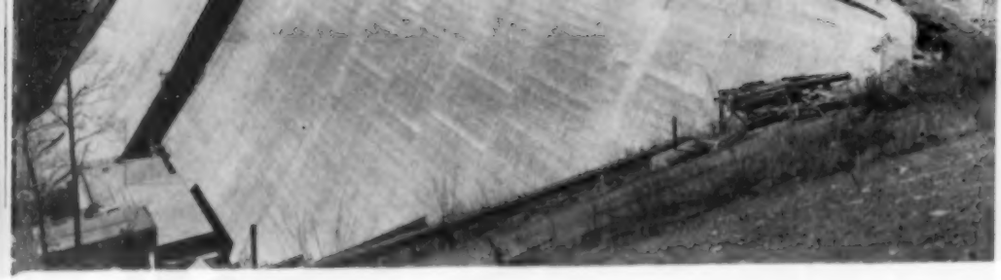
No cutoff trench was used. This matter was discussed with the consulting geologists, who thought that the extra blasting necessary would leave the surface of the trench in such a shattered and broken condition that the resistance to percolation under the dam would be less than if no cutoff trench were excavated. This contention was not because of any particular condition or property of the Hiwassee foundation rock, but was thought to be generally true of cutoff trenches in foundations where the rock is good.

Another important feature in the foundation excavation and design was the use of fillets at the upstream and downstream toes, the general scheme of which is shown in section in Fig. 2. Photoelastic experiments show that high stress concentrations exist in the foundation rock at the toe of the dam, with full reservoir, and at the heel, when the reservoir is empty; they further show that rounded fillets noticeably lessen these stresses. The downstream fillets, as used at Hiwassee, are not rounded but as a practical matter are made with two additional flat surfaces instead, beginning with the downstream face of the dam extending from above, then a surface having a slope of 1 on 2, then a horizontal surface running out to and abutting against the nearly vertical rock cut at the toe of the dam. The fillets, in addition to relieving the concentration of stress in the foundation rock, are so shaped that the vertical rock face can take considerable of the downstream thrust.

RAINFALL AND RUNOFF DATA FOR THE WATERSHED

The Hiwassee River is in a region of intense rainfall, averaging 57 in. annually over 54 years, with a maximum of 80 in. The largest flood on record was 56,000 cu ft per sec at Reliance, Tenn., a stream-gaging station about 20 miles downstream from the dam with very little tributary drainage between. A flow of 42,000 cu ft per sec occurred at the dam site on February 4, 1936, when foundation exploration was in progress. To estimate the maximum floods to be expected within the Tennessee River Valley, a board of consulting engineers consisting of the late Harrison P. Eddy, Ivan E. Houk, Gerard Matthes, and Daniel W. Mead, Members Am. Soc. C.E., recommended the use of the formula:

$$\frac{5,000}{\ldots}$$



or a line of grout holes near the upstream face of the dam; and blanket grouting, or general grouting over the entire remaining area of the founda-

HIWASSEE DAM, PRACTICALLY COMPLETE
General View Looking North, as of April 1940

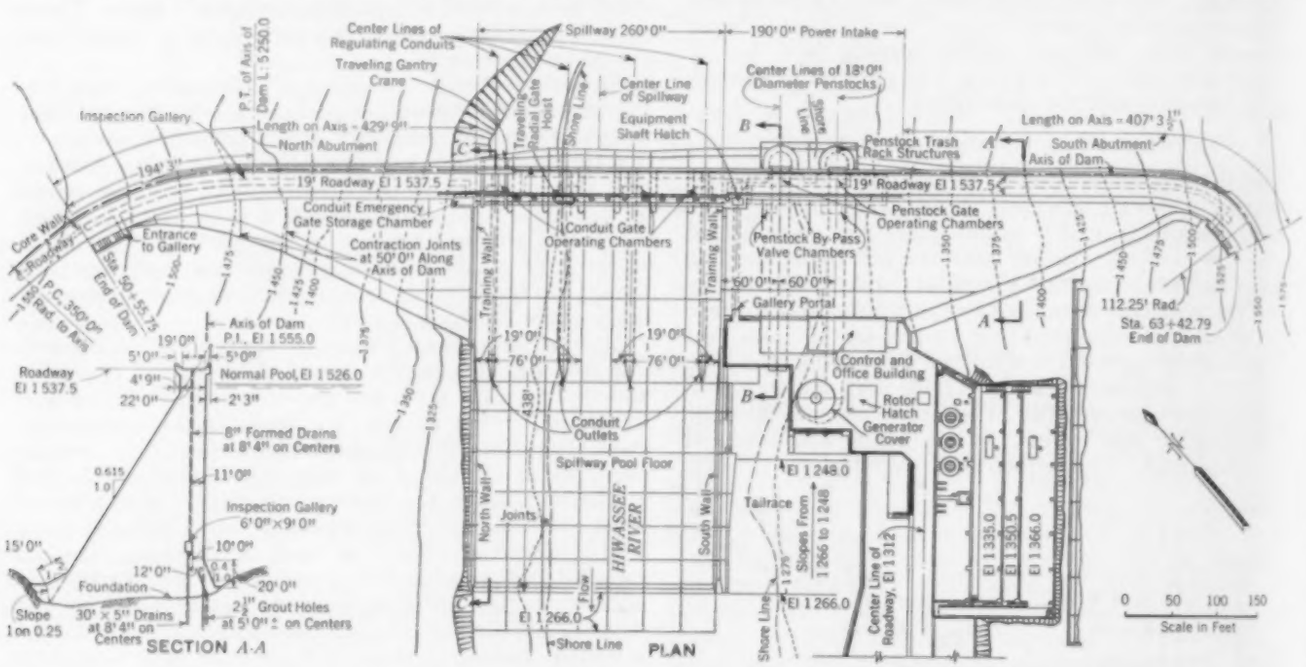
feet per second per square mile, and A is the drainage area in square miles.

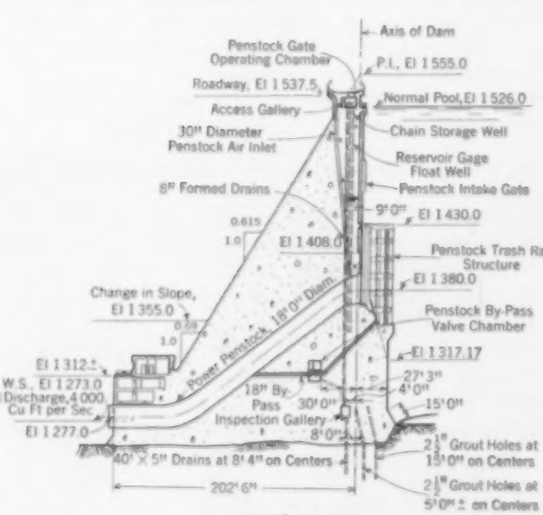
However, a study of the rate of runoff in similar areas in the Tennessee Valley indicated that the constant should be increased from 5,000 to 6,000. This latter formula, applied to the drainage area of 977 sq miles at Hiwassee, gives a runoff of 192 cu ft per sec per sq mile, or a peak discharge at the dam site of 187,500 cu ft per sec. A reservoir operation study with the assumed hydrograph indicates that this amount will be reduced to 150,000 cu ft per sec as the necessary discharge past the dam. This flood discharge is provided for by an overflow spillway having a capacity of 130,000 cu ft per sec and four regulating conduits or sluice outlets having a total capacity of 20,000 cu ft per sec. The latter rather large regulating capacity was arrived at as a result of reservoir operation studies based upon flood-control requirements. The discharge, area, capacity, and tailwater curves are shown in Fig. 3.

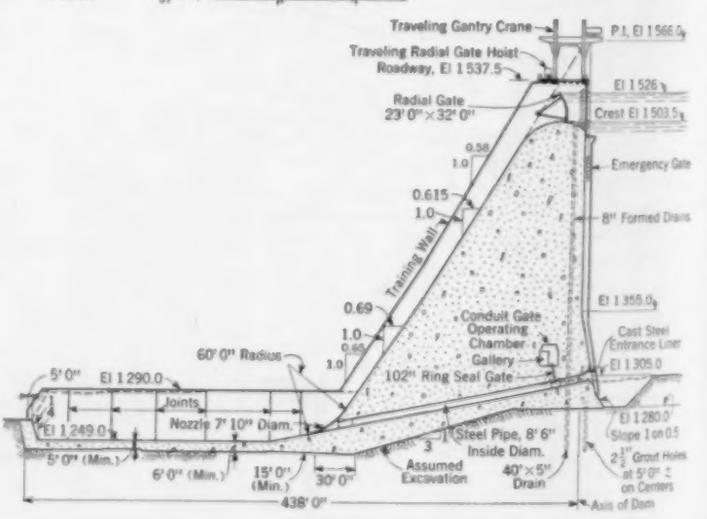
Several different types and locations of spillway were considered and investigated. The design finally adopted was one having the conventional hydraulic-jump pool. Hydraulic laboratory tests determined the type adopted and also the controlling dimensions. The spillway was designed for best efficiency at 75,000 cu ft per sec, which is a greater flow than has ever occurred and is as great as it is reasonable to expect after the reservoir is put in operation. However, tests were also run up to 150,000 cu ft per sec, and while the hydraulic jump was not perfect for this flow, the river channel downstream has an excellent solid rock bed and can stand heavy turbulence for such short periods of time as would be involved with any such flow.

SPILLWAY DESIGN DEVELOPED

Various shapes and lengths of spillway pool were tried. In general, it was found that those which had a long flat slope entering the pool were not as efficient as those which led the water into the pool steeply by a short-radius curve between the dam and pool floor. Also, a nearly vertical wall at the downstream end was shown to be better than a sloping one, as it prevented the water from sweeping through freely and set up a roll or upstream motion of some of the water, thus helping to







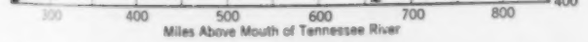


FIG. 1. PART OF THE TENNESSEE VALLEY, SHOWING LOCATION OF HIWASSEE DAM

Gerard Matthes, and Daniel W. Mead, Members Am. Soc. C.E., recommended the use of the formula:

$R = \frac{5{,}000}{\sqrt{A}}$, in which R is the rate of runoff in cubic

dissipate energy not fully taken care of by the hydraulic jump.

For the spillway discharge R. N. Brudenell, Jun. Am. Soc. C.E., at the University of Iowa (now with the

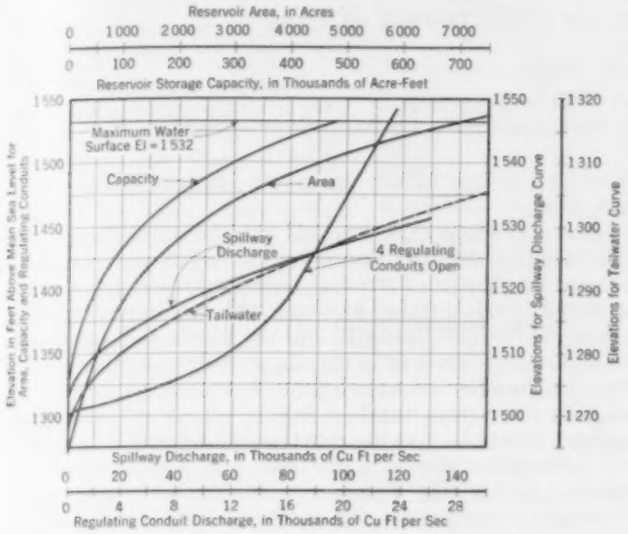


FIG. 3. HYDRAULIC AND AREA CURVES FOR HIWASSEE DAM

Tennessee Valley Authority) developed the formula: $Q = \frac{3.80LH^{1.62}}{D^{0.12}}$, in which L is the length of the crest; H, the actual head; and D, the design head on the crest (28.5 ft).

To insure positive pressures on the concrete surface, the surface of the overflow weir was made higher than the theoretical under side of the nappe for maximum discharge. The spillway was lined with concrete throughout, as indicated in Fig. 2, Section *C-C*. The floor of the pool was not reinforced but was doweled with $1^1/_4$-in. square bars spaced 6 ft on centers both ways. These extended 6 ft into rock, as it was thought that the dowels would be more effective than general slab reinforcement against any uplift tendencies or any possibility of concrete being torn out by the high velocity of the water coming over the spillway.

The south spillway wall next to the power house was designed as a reinforced concrete cantilever against both ultimate loads and unusual loads during construction. The north wall was doweled to the rock against which it was placed and was also temperature-reinforced with $^3/_4$-in. round bars on 12-in. centers both ways, 5 in. from the surface.

There are four sluice outlets (Fig. 2), with an inside diameter of 102 in. Each outlet consists of a cast-steel bell-mouth intake at the upstream end, followed by a short section of heavy plate steel pipe, a ring-seal gate, a conduit through the dam lined with steel-plate pipe, and a steel-plate nozzle at the downstream end. (See Section *C-C*, Fig. 2.) The outlets are circular in cross section all the way through.

The control gate is of the ring-follower type, so that when the gate is wide open, the passageway through the gate is a smooth cylinder. The required circular seal and the tractive means were developed by the Bureau of Reclamation for the Grand Coulee Dam, the resulting gate being known as a "ring-seal gate."

It is thought that the absence of the somewhat con-

the cross section and tend to reduce the formation of vacuum and cavitation. The upstream face of the dam is also made truly perpendicular to the axis of the bell-mouth entrance so that the water will enter as nearly symmetrically as possible, thus providing the most nearly uniform velocities obtainable.

In addition, the outlet is made in an absolutely straight alinement, so that no changes in direction of the high-velocity water are required. All these conditions are thought to minimize the possibility of the formation of a vacuum or cavitation and consequent pitting. The bell-mouth has a cast-steel instead of a cast-iron lining, so that the pipe section between it and the gate could be welded to it. The proposed bell-mouth entrance was tested in the hydraulic laboratory at the Carnegie Institute of Technology by H. A. Thomas, M. Am. Soc. C.E., professor of hydraulics, who had previously developed methods for testing the entrances to Madden Dam.

Since models are reduced in scale, the forces are reduced; but the atmospheric pressure remains the same. Hence the usual model tests, where vacuum conditions are concerned, may be of little value. To offset this difficulty, Professor Thomas put the whole model in a vacuum tank with pressures reduced in proportion to the scale reduction, and then ran water through the model and measured pressures at various points along the bell-mouth curve by means of piezometric connections. Also, by trial and error he has found a composition of plaster of paris, portland cement, whites and and water, which upon test produces cavitation in the model corresponding to the actual cavitation that occurred at Madden Dam.

RESULT OF LABORATORY TESTS ON SLUICE OUTLETS

One might suppose that if the curve of the bell-mouth were made with a greater convergence than the natural vena contracta past the upper end of the opening acting as an orifice, thus continually choking the water in its downstream path, no trouble from vacuum or cavitation would result, and such a condition would certainly be a rational criterion for design. However, the hydraulic laboratory tests showed that the amount of convergence need not be nearly as much as dictated by this criterion, and that the smaller opening at the upstream end results in considerable economy in the reduced size of the emergency gate at the upstream face of the dam, as well as economy in the reduced size of the bell-mouth intake casting itself.

A fixed nozzle was provided at the downstream end of the outlet, tapering from 8 ft 6 in. to 7 ft 10 in. in a distance of 10 ft in order to make the downstream end of the conduit the critical section at all flows. This produces a back pressure or hydraulic gradient above the top of the pipe. By making the hydraulic gradient at the lowest point a distance above the pipe equal to a head of one atmosphere, any local formation of vacuum conditions along the conduit may be offset by the pressure head, at least to the extent of not permitting a cumulative effect of the vacuum formation. In order to check the internal behavior of the conduits during operation, piezometers were placed along one of the pipes.

The design and construction work has progressed with unusual smoothness and the project is substantially complete. The gates of the dam were closed on February 8, 1940, and water was impounded for flood control and later low-water releases. The power plant, originally scheduled for initial operation in February 1941,

FIG. 2 GENERAL PLAN AND SECTIONS, HIWASSEE DAM

Fatigue Provisions in Riveted Joints

Review of Present Knowledge, and Limitations in Its Application—a Paper from the Structural Division Program at the 1940 Annual Meeting

By JONATHAN JONES

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TO define the type of fatigue applying to structural steel—it is that which causes a piece or joint to fail at a stress below its static ultimate, if this stress be applied, then released or reversed, then again applied, and so on for a large number of cycles. Unless about two-thirds of the total stress is released and re-applied at least several thousand times, the fatigue strength is not far enough below the static ultimate to need consideration in design.

Fatigue therefore is probably of no consequence in tier building frames although, since wind stresses are released, re-applied and even reversed, that statement requires proof. British investigators have produced an analysis pointing toward such a conclusion, in the report on "Welding of Steel Structures," by the Welding Panel of the Steel Structures Research Committee (London, 1938, page 13).

Again, fatigue is of no consequence in the chord joints of long, simple-span bridges. Here the dead-load stress, which is never released, is so large a proportion of the total stress that removing and re-applying the live load an indefinte number of times would not cause failure unless the static yield point were exceeded by the maximum stress in the cycle. Since the chords are always stressed below the static yield point, they need nothing further to strengthen them against fatigue.

Fatigue strength is of maximum consequence in connections such as those of stringers, floor beams, and floor-beam hangers, which are practically released from stress after the passage of each load; and on such as those of the central web diagonals of Warren trusses, which reverse under the passage of each train.

Since the fatigue strength of some members may be relatively low, and provision for it costly, specifications are likely hereafter to become somewhat complex. They will have to be so drafted as to make only just that provision, in each individual structure and in the individual members of that structure, which is indicated as necessary for their respective probable types of stressing—and not any more. To speak in terms of a single unit stress, as 16,000, or 18,000, or 20,000 lb per sq in., will be wasteful in one case, dangerous in another.

In 1934, F. H. Frankland, M. Am. Soc. C.E., translated and distributed in this country Dr. Schaechterle's important summary of the German work up to that point. The only comparable work in this country, that of W. M. Wilson, M. Am. Soc. C.E., at the University of Illinois, was published in detail in "Fatigue Tests of Riveted Joints" (Bulletin No. 302, University of Illinois Engineering Experiment Station, 1938). The only quantitative comment I would make is this: the use of a bearing pressure has no adverse effect upon the fatigue strength of the joint.

How can these experimental data be manipulated into specification form? For every different percentage of release or change of stress in repeated stressing, there is a variable relationship between the maximum stress in the cycle (fatigue strength) and the number of repetitions, or cycles, required to bring about failure at that stress. As the number of repetitions is increased from 1 to 50,000, there is a marked falling off of the maximum stress endurable. As the repetitions increase from 50,000 to 2,000,000 there is a further, but a proportionally, smaller falling off. From, say, 10,000,000 to an infinite number of repetitions, the further falling off is insignificant. In other words the stress-number, or S/N (so-called Woehler) curve, plotted with number of cycles as abscissa and fatigue strength as ordinate, falls sharply from the y-axis ($N = 0$), where it represents static strength, then falls less rapidly, and finally goes off almost horizontally to the right after N exceeds a few million. A typical curve for riveted joints is shown in Fig. 1.

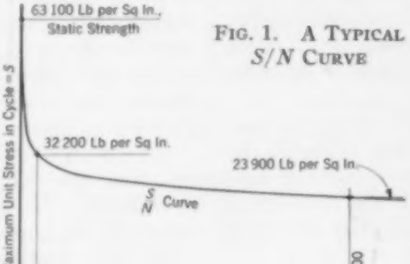

63 100 Lb per Sq In.,
Static Strength
32 200 Lb per Sq In.
23 900 Lb per Sq In.
S/N Curve
Maximum Unit Stress in Cycle = S
Number of Cycles = N

FIG. 1. A TYPICAL S/N CURVE

PRACTICAL COMPUTATION OF FATIGUE STRENGTH

For every type of repeated stressing we should like to know a number of points on the S/N curve. Then, for a connection that we might estimate to endure, say, 80,000 repetitions during the life of the structure, we should be able to scale off the exact fatigue strength and design the connection accordingly.

Neither time nor money will ever permit us to do so much. All we can hope for is to get about three points on each of a few such curves, and trust that the curve we pass through these points will be sufficiently exact. One of these three points is obviously the static strength, where the repetitions are zero in number—in other words, the starting point on the y-axis. The choice of the other two points calls for some thought.

Engineers have considered that a large number of members in a railroad bridge, such as floor-beam hangers, may receive about 2,000,000 repetitions of maximum stress in their desired lifetime. Similar members in a highway bridge, where loading and unloading are incessant but where the assumed maximum load occurs far less frequently, may receive 100,000. These assumptions are always subject to review. They have led, in the work done thus far, to our seeking to find the stress that produces failure at 100,000 cycles, and the still lower stress that produces failure at 2,000,000 cycles. This, then, is the sort of data we now have and are seeking to amplify.

Given the outlines of any bridge, it is easy to find for each member the minimum and the maximum stress

reclamation for the Grand Coulee Dam, the resulting gate being known as a "ring-seal gate."

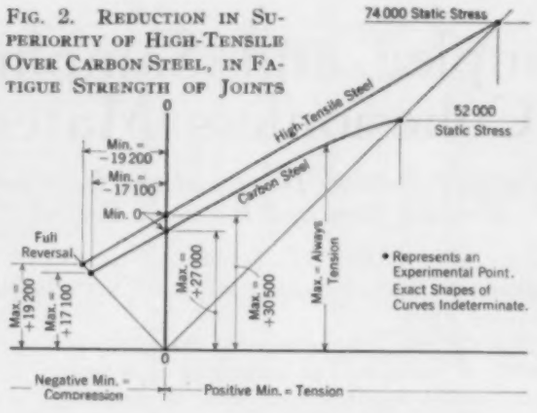
It is thought that the absence of the somewhat conventional transition, from a round to a rectangular gate and back again, will minimize the unequal velocities in

ruary 8, 1940, and water was impounded for flood control and later low-water releases. The power plant, originally scheduled for initial operation in February 1941, is now practically completed, and should be placed in commercial operation during the summer of 1940.

may be the dead-load stress reduced by a temperature effect. For others it may be the dead load reduced or reversed by a live-load stress of the opposite sign.

Suppose that the minimum stress, which may be simply the dead-load stress, is as much as one-third of the total, which may be the dead-load plus the live-load stress; we have already stated that fatigue need not be considered. When the spread between minimum and maximum stress is greater than that, fatigue becomes a consideration. How much strength, and therefore cost, must be added?

FIG. 2. REDUCTION IN SUPERIORITY OF HIGH-TENSILE OVER CARBON STEEL, IN FATIGUE STRENGTH OF JOINTS



First we must consider, for this member, how many times we estimate that this cycle will be repeated. Having decided that, from the appropriate S/N curve we scale off the fatigue unit stress, which is less than the yield point. To this we apply a factor of safety, and thus we proportion the member. In selecting the factor of safety, judgment must again enter. If the number of cycles is certain in our minds, we need as large a factor of safety as anywhere else; if it is possible but highly improbable that so many repetitions will occur, we can do with a smaller factor. In other words, we must not be stampeded by all these low values found in the research; we must not become wasteful by building in unwarranted and unbalanced strength.

This difficulty does not make for simplicity in specifications, and it does not make for the application of one standard specification to all manner of structures, as is now too often done. As an example, consider the chords of continuous trusses in highway bridges—a type having many merits, now coming into greater recognition. These chords are subject to reversal in computed stress, the condition giving the lowest safe stresses in fatigue. Should these chords, therefore, be increased 50% in area? It has been done; but it certainly will not be done if the designer stops to realize the extreme improbability of getting millions of repetitions of the parade of trucks and tanks required for the specified maximum load.

REVERSAL, IN CARBON AND HIGH-STRENGTH STEELS

American specifications have long included a reversal clause, and it has been carried over from railroad into highway bridge specifications. That clause appears to be in good accord with the findings as to fatigue strength at 2,000,000 reversals. Hundreds of tons of steel have been built into members that never needed it, all because that clause was applied in cases where such a number of repetitions of maximum stress is unthinkable.

Many engineers have been startled by the finding, in which foreign and American tests agree, that members and joints of silicon and other structural high-strength steels show up badly as regards fatigue, even being under reversal only a trifle better than carbon steel. At present this is attributed to inferior clamping, early slip, and lower ductility. Judging by many specimen joints sawed open for examination, I do not believe that this results from inferior filling of holes. Partly it must be due to the fact that the bolting up of high-yield-strength plates does not force them into permanent contact; partly, where high-strength rivets have been used, it

This is illustrated in Fig. 2, which is believed by the writer to be the most convenient form of chart for expressing the fatigue strength of steel under pulsating or reversing loads. It will be seen that loads to the right of the vertical axis are pulsating, and loads to the left of that axis are reversing. In all cases the abscissas are the minimum, and the ordinates corresponding to such abscissas are the maximum, unit stresses which in the same cycle of maximum and minimum, alternating two million times, will occasion fatigue failure at the maximum stress in the cycle. It will be seen that a steel which has a 40% higher value than ordinary carbon steel when tested in static tension, has only 12 to 13% advantage when the stress fluctuates considerably.

DISCRIMINATION IN CHOICE OF STEELS

But again, when one inquires how many members in silicon-steel bridges, most of which necessarily are of long span with high dead-load stresses, will have to endure millions of repetitions of widely fluctuating or reversing stress, one finds more exemptions than occurrences. The data emphasize the unwisdom of using high-strength steels indiscriminately, where they really are not required. Some years ago, when the Iron and Steel Structures Committee of the A.R.E.A. brought out a specification permitting the use of silicon steel, it posted this sound advice:

"Of two spans of equal cost in place, the heavier one (carbon steel) is the better purchase."

Now we see another reason why that advice is good. Recently, in line with the thoughts just expressed, it has added the following:

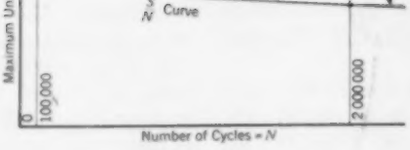
"The following (alloy steel) unit stresses shall not apply to members which will be subjected to a large number of stress cycles during the life of the structure, and having either reversal of stress or low dead-load stress, on account of the possibility of fatigue failure. For such members, the allowable unit stresses shall be suitably reduced, and in floor systems shall not exceed the allowable unit stresses for carbon steel."

Obviously the expression "suitably reduced" is a stopgap. The determination of a suitable reduction is a complex matter, as I have tried to show. Here, however, is concrete evidence of the intention of bridge designers to take their fatigue data seriously, and to apply them only just where needed.

The study of fatigue in riveted joints is as important as it is fascinating—and at times perplexing. It will lead to design procedures slightly more involved, but more logical. It may, through reconsideration of our old reversal rule where that rule is unwarranted, eliminate as much cost as it may introduce elsewhere. In any event, important as it is, it is important only in parts of any bridge, and is not going to produce many headaches with existing bridges nor add greatly to the cost of future ones.

But the point requiring most emphasis is this—while on welded joints fatigue testing is now going forward on a hopeful scale, only pilot work has been done on fatigue of riveted joints, and none at all on reversal of stress.

periment Station, 1938). The only quantitative comment I would make is this: the use of a bearing pressure (40,000 lb) twice the net tension (20,000 lb), as has been permitted by A. I. S. C. Specifications since 1936,



Given the outlines of any bridge, it is easy to find for each member the minimum and the maximum stress for the stipulated loadings. For many members the minimum stress is the dead-load stress. For others it

Improved Sampler and Sampling Technique for Cohesionless Materials

Description of Equipment and Methods Developed and Used for the First Time on the Denison Dam and Reservoir Project

By H. L. JOHNSON

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THE importance of "undisturbed samples" in connection with foundation investigations needs no stressing. The problem is how to secure such samples—particularly in cohesionless materials. Mr. Johnson here presents an interesting solution, which he has found to give good results in all materials except gravels, or sands and clays containing considerable gravel. The method utilizes a new type of sampler, but standard core-boring equipment. Commercial drilling mud maintains the hole, eliminating the need for a casing. The article concludes with Mr. Johnson's evaluation of the method, based on results obtained.

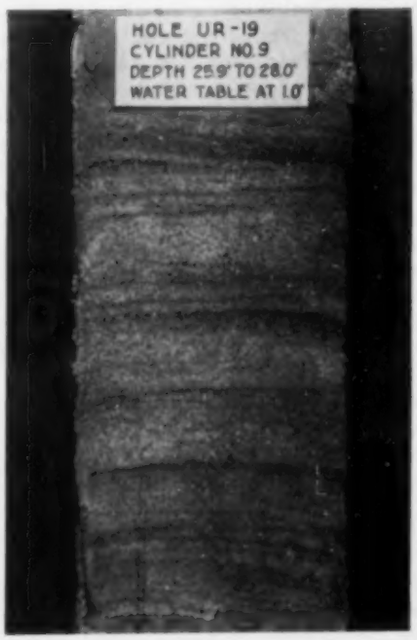
IN conducting investigations of foundation conditions at the site of the Denison Dam, situated on the Red River approximately five miles north of Denison, Tex., it was found necessary to take numerous undisturbed samples of cohesionless material for laboratory tests. This material was predominantly alluvial sand containing lenses and localized beds of clay, gravel, and mixtures thereof. This material ranged in thickness from 20 to 60 ft and extended from the river bed (below the water table) to the terraces on the Oklahoma side of the river (above the water table).

Various types of samplers and sampling methods were tried but with very poor success, especially in attempting to obtain samples approximately 6 in. in diameter at the greater depths or below the ground-water table. After considerable experimentation, the author and R. A. Young, driller foreman, adapted a 6-in. double core barrel as a sampler and developed a procedure of operation that was reasonably successful. The equipment proved capable of taking undisturbed samples in all materials except gravels, or sands and clays containing considerable gravel.

This method of sampling is simply a combination of jacking, coring, and jetting techniques. The hydraulic feed of the drill rig acts as a jack to force the sampler downward, while the rotating outer barrel reams out the hole and loosens the material just behind the sampling shoe. The circulating drilling mud acts as a jet and removes cuttings and surplus material from the hole. (See Fig. 1.) The resistance to penetration by the sampler is kept to a minimum and makes it easily possible to sample to greater depths, or in materials that would ordinarily require the use of deadmen and immensely heavy anchors to jack against.

In this method the major unit of equipment necessary is a drill rig capable of handling a double core barrel cutting cores 6 in. in diameter and exerting a total downward thrust of one to two tons on the core barrel when drilling. The rig used at the Denison Dam site is of the truck-mounted type.

The sampler is essentially a heavy-duty 6-in. double core barrel



SECTION THROUGH CENTER OF TYPICAL

swivel, core catcher, check valve, and cutting shoes. Details of this sampler are shown in Fig. 2. It incorporates all changes and improvements found necessary in order that the equipment might withstand the punishment to which it was subjected. The sample tube is made of 28-gage galvanized sheet metal, rolled and shaped to a true cylinder 24 in. long and $5^{15}/_{16}$ in. in outside diameter, with joints of $^1/_4$-in. lap, soldered and flush on the outside. Such equipment as chain, chain and spanner wrenches and boomers, necessary to operate and service the sampler, are standard products.

In practice, the upper 4 ft of material is sampled with a small Shelby tube sampler and the hole enlarged by use of a fishtail bit. Enlarging of the hole is necessary for the installation of a length of casing (Fig. 1), which permits insertion of the core barrel sampler and prevents caving of the hole at the surface. This operation is essential because the hydraulic feed of the drill rig is not high enough above the ground to permit starting the hole with the core barrel sampler.

After the casing is set, it is washed out to the bottom—that is, to a depth of 4 ft—by use of the circulating pump and artificial drilling mud. Drilling mud is used in lieu of casing for the remainder of the hole and the hole is kept full of mud at all times. The mud plasters over and supports the walls of the hole below the casing and prevents caving. The mud, being thick and jelly-like, does not penetrate or contaminate the sample except for a fraction of an inch at the ends. Best results are obtained with drilling muds that are thixotropic. (Thixotropy is the property or phenomenon exhibited by some muds or gels, of acquiring a temporary set when undisturbed and becoming fluid when agitated, the change being reversible.) The mud is colored to facilitate determining the extent of its penetration into the sample.

In operation, the core-barrel sampler is lowered to the bottom of the hole and the hydraulic feed actuated to exert a downward pressure of 100 to 250 lb per sq in. on the sampler. The circulating pump is then started, and when circulation of mud is established in the hole, the outer barrel is

plates does not force them into permanent contact; partly, where high-strength rivets have been used, it may be due to a different cooling behavior. At any rate, the data on fatigue strength of alloy joints are most disappointing.

On welded joints fatigue testing is now going forward on a hopeful scale, only pilot work has been done on fatigue of riveted joints, and none at all on reversal of stress. Hence a survey such as I have attempted must remain in general terms until further research can be financed, and the quantitative data obtained.

rpm and the sample taken. This order of procedure insures that the shoe of the stationary inner barrel will be forced down into the material being sampled prior to the circulation of drilling mud, eliminating the possibility of the sample's being wholly or partially washed away. This order of procedure must be constantly observed if uniformly consistent results are to be obtained. The matter of procedure is emphasized because it is the reverse of that used in normal drilling operations, and drillers usually display a remarkable tenacity of habit.

When a sample run is started, the circulating pump should be operated slowly at first and its speed gradually increased until the sampler is penetrating the overburden at the rate of approximately 1 ft per min. The hydraulic pressure on the sampler is kept constant. Other conditions being equal, the rate of penetration by the sampler is dependent upon the jetting action of the drilling mud. For this reason, best results are obtained with an independent circulating pump capable of wide and easily controlled variations in output and pressure. The related functions of the pump, drill rig, and sampler are shown diagrammatically in Fig. 1. This figure also shows the travel and action of the drilling mud in the two types of samplers.

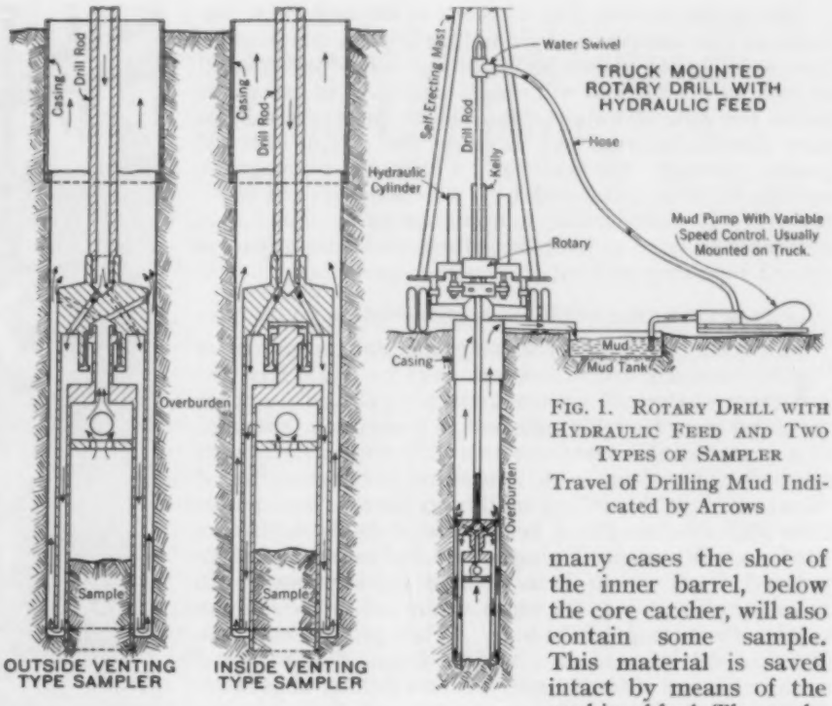
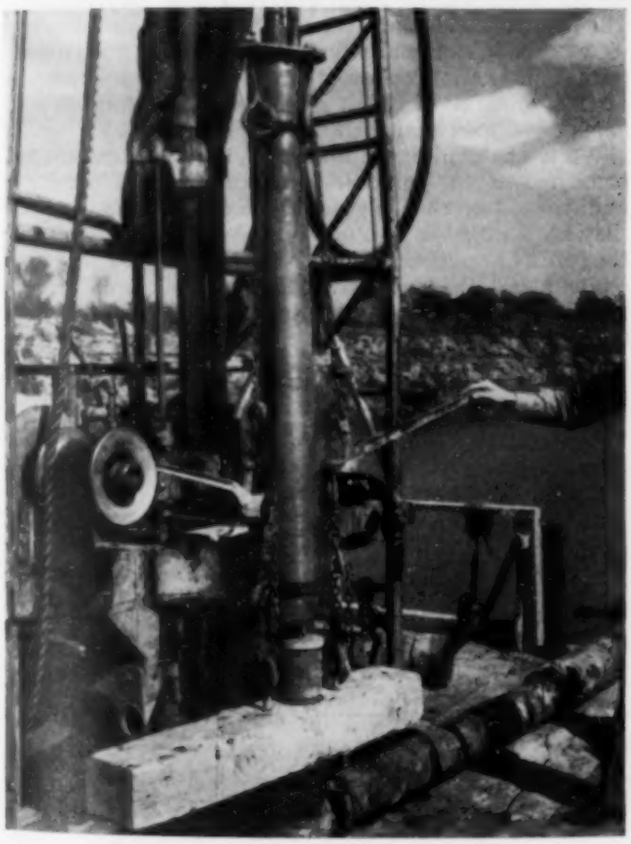


FIG. 1. ROTARY DRILL WITH HYDRAULIC FEED AND TWO TYPES OF SAMPLER
Travel of Drilling Mud Indicated by Arrows

When the sampler has penetrated as far as it will go, or a full run has been made, the pump and drill are stopped and the sampler withdrawn from the hole. In many cases the shoe of the inner barrel, below the core catcher, will also contain some sample. This material is saved intact by means of the pushing block. The pushing block, chain yoke, and boomers are rigged on the sampler with the pushing disk in place, as shown in an accompanying photograph. The material in the shoe of the inner barrel is then forced up into the sample tube, which was inserted in the inner barrel prior to the run. Thus the entire sample recovered is saved intact in the sample tube. The sample tube is shown in Fig. 2.



In order to remove the sample, the pushing block and chain yoke are unrigged, the sampler raised, and the outer and inner barrel shoes and core catcher removed. The edges of the sample cylinder are bent inward to prevent the pushing disk and sample from sliding out. The sample tube is then extracted from the inner barrel with the aid of a pair of tongs, as shown in an accompanying photograph. Excess drilling mud is ladled out of the top of the sample tube; a wooden sealing disk is inserted firmly against the top of the sample; and sealed in with quick-setting plaster. The sample tube is inverted after the plaster has set; the pushing disk is withdrawn and replaced with a sealing disk; and the same sealing procedure repeated. The sample tubes are kept in an upright position at all times until both ends have been sealed. After labeling, they are ready for transportation to the laboratory.

Three lengths of outer barrel shoes are used (Fig. 2). This assortment of shoes permits sampling any type of deposit except rock and coarse gravel. When sampling a loose, easily washed material, the short shoe is used. The medium-length shoe is for hard packed or washing-resistant sands, soils, and clays. The longer shoe is used only in gravel or materials containing gravel large enough to cause the inner barrel to ride on them and prevent further penetration. All other variations are obtained by controlling the circulation of drilling mud and its resultant jetting action. The proper use of the outer barrel shoes and pump control must be learned by experience in each locality.

After each run the check valve in the inner barrel (Fig. 2) should be inspected via the open end of the barrel to see that it is not plugged up. This valve and the ports in the inner barrel or in the swivel and head serve to vent

type.

The sampler is essentially a heavy-duty, 6-in., double core barrel equipped with special heads and

SECTION THROUGH CENTER OF TYPICAL SAMPLE OF UNDISTURBED OVERBURDEN MATERIAL

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The circulating pump is then started, and when circulation of mud is established in the hole, the outer barrel is started rotating at approximately 60

The spring catcher (Fig. 2) is one of the important features of this sampler and should be kept in good condition. All lost or broken spring prongs should be replaced at once or sample loss will result, especially in fine sands below the ground-water table. These springs should be very flexible in order not to gouge the sample when it passes through the catcher. Clock or phonograph springs 0.016 in. thick and 1 in. wide have proved satisfactory. If considerable sampling is to be done, it is advisable to have at least six spring catchers on hand to permit repairing without suspending operations.

SAMPLING PROCEDURE FOR TWO SPECIAL CASES

Below the water table, in very fine and incompact or "quick" materials, it will occasionally be found that the resistance of the drilling mud to venting from the sample tube and inner barrel is sufficient to prevent the entrance of a sample. To overcome this difficulty a fairly stiff mud plug, 3 or 4 in. thick, is inserted in the inner barrel shoe to exclude the drilling mud from the shoe and sample tube while the sampler is being lowered to the bottom of the hole. When a mud plug is used, the sampler must be lowered slowly or the induced hydrostatic pressure will force the plug up into the sample tube before the sampler reaches the bottom of the hole. When proper procedure is followed, the mud plug will be found tightly seated against the top of the sample, with no drilling mud intervening, when the sample tube is removed from the core barrel at the end of the run.

In soft and fatty clays it will be found that the walls of the hole will tend to "squeeze" with depth and prevent the free entrance and withdrawal of the sampler. This condition will cause the sampler to shave clay from the walls of the hole on succeeding runs and will result in excess sample. This condition can usually be remedied by reaming the hole with a fishtail bit of slightly greater diameter than the sampler and washing out after each run.

No special provisions have been made for the removal of samples from the sample tubes or cylinders. At the laboratory the samples are removed by drawing a stiff-bladed knife along the soldered seam and gently unrolling the cylinder. After the samples have been removed, the sample tubes are cleaned, rerolled, resoldered, and used again.

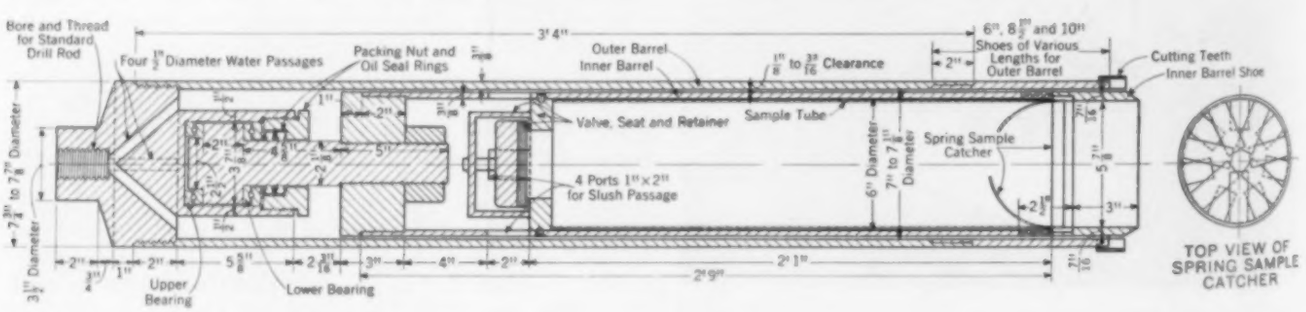
RESULTS OBTAINED ON THE DENISON PROJECT

Approximately 1,100 linear ft of materials have been sampled in holes ranging from 20 to 60 ft in depth and predominately below the water table. The poorest recovery was 41%, the best 92%, and the average 70%. The best results have been obtained in materials above the water table, and in clays, irrespective of their orientation with the water table. Fine sands below the water table have been the most difficult to sample satisfactorily, and undisturbed samples of large gravel or materials containing considerable large gravel are an impossibility. The results obtained are considered highly satisfactory in view of the variety of materials encountered, the ground-water conditions met, the depths to which sampling was carried, and the fact that methods and equipment were being developed during the course of the work.

CUTTING SHOES REMOVED, SAMPLE TUBE BEING WITHDRAWN FROM CORE BARREL

While the equipment and methods described are not presented as the solution to all problems of obtaining undisturbed overburden samples of cohesionless material, they are thought to be a new and worth-while addition to the present existing array of samplers and sampling techniques. It is believed that if the basic principles set forth here are utilized, and applied with a modicum of common sense, results equal to or better than those secured on the Denison project can be readily achieved.

The Denison District, in the Southwestern Division of the U.S. Engineer Department, has its headquarters at Denison, Tex. Lucius D. Clay, M. Am. Soc. C.E., Captain, Corps of Engineers, U.S. Army, is the District Engineer. The writer is a foundation engineer on the Denison Dam and Reservoir Project.



PUSHING-BLOCK ASSEMBLY FOR SAVING SAMPLE IN CUTTING SHOE BY PUSHING IT UP INTO SAMPLE TUBE

(Fig. 2) should be inspected via the open end of the barrel to see that it is not plugged up. This valve and the ports in the inner barrel or in the swivel and head serve to vent the drilling mud from the sample tube as the sample fills the tube.

Pollution Abatement in New York Area—Progress West of the Hudson

By C. J. VELZ

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IN the May issue, Seth G. Hess described the formation, operations, and general plans of the New York–New Jersey Interstate Sanitation District. This month Professor Velz continues the series on pollution abatement in the Metropolitan area with a discussion of specific problems in municipalities west of the Hudson, where progress is complicated by the multiplicity of governmental units involved. His paper constitutes a sound and convincing argument for the importance of cooperation both among municipalities and between municipalities and industries in attacking the pollution problem. It is from the Society's 1940 Annual Meeting program of the Sanitary Engineering Division.

THE general pollution situation in the entire Interstate Sanitation District is overshadowed of course by the magnitude of the problem created by New York City itself. The problems west of the Hudson, however, are not less important to the District; they are, in fact, the real challenge to the Interstate Sanitation Commission and the compact method of administration. In so far as the Commission is concerned, the New York City work is relatively simple. Only one political unit is involved and that unit, in self-interest, has finally recognized its responsibility and is methodically going about the task of correction on its own initiative. West of the Hudson a multitude of political units are involved, pollution due to industrial wastes is acute, and populous and highly industrialized contiguous areas have their main drainage outlets in the District.

SUBJECT DIVIDED INTO THREE NATURAL DRAINAGE AREAS

Regardless of political or district boundaries, the stream pollution problem is inevitably defined by natural drainage areas. Let us consider three subdivisions which I shall designate as the Hudson River, the Raritan River, and Newark Bay.

The interrelation of the Hudson River to the District and the picture of conditions in that area are indicated by Fig. 1, showing the dissolved-oxygen profile of the Hudson. Two zones of serious depletion of dissolved oxygen will be noted—one below the Albany-Troy metropolitan area and the other in the lower Hudson and harbor. Notwithstanding the heavy pollution load contributed in the upper valley, the river enters the Interstate District just above Peekskill with a debt equivalent to a population of about 20,000, as an unsatisfied residual from all upstream pollution, and with assets in dissolved oxygen of about 70% of saturation. Furthermore, of this debt less than 2,000 remains unsatisfied at the lower end of Tappan Zee, while the dissolved oxygen content is increased to about 85%. I do not mean to infer that the upstream pollution problem is adequately solved (as a glance at the dissolved oxygen sag below Albany will verify); what is important to note here is simply that the gross degradation of the lower river and harbor results from the pollution contributed within the District.

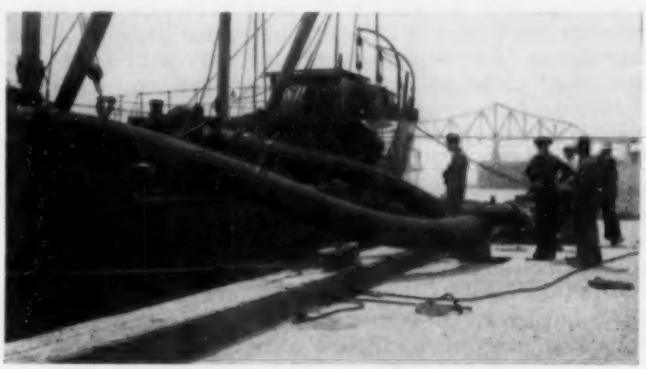
Along the upper west bank of the Hudson reasonable progress is being made in pollution abatement, largely as a result of the financial aid offered by the Federal Public Works Administration. Most of the problems in that area are primarily local ones, although certain logical combinations present themselves.

In Fig. 2 are shown the areas along the lower west

treatment is provided. Notwithstanding the fact that the communities involved have plans for treatment, the basic studies necessary for a sound solution have not yet been presented. Much less has any practicable, comprehensive plan been crystallized. In this area the west bank is a patchwork of political units ranging from the town of Guttenberg, four blocks wide, to the community of Jersey City. In a distance slightly greater than the length of Manhattan Island, two counties and twelve municipalities are encountered.

How shall the problem of sewage treatment be approached in this patchwork? The expense and lack of efficiency associated with a plan for each political unit to build and operate its own plant must be obvious to the most casual observer. On the other hand, the difficulties of a completely coordinated plan at times seem insurmountable. The problem of coordination and integration of this character is not peculiar to the field of pollution alone; we are met with it in every phase of modern urban society, until its solution becomes one of the pressing needs of this generation. We cannot hope to obtain a perfect solution within a reasonable period of time, but we cannot afford less than a practical integration by joint action within logical service areas. The greatest obstacle to integration is an inherent fear and lack of confidence on the part of the small units of government toward what are regarded as extravagant schemes. A program should stand or fall on its merits, and it is the responsibility of the engineering profession and the duty of regulatory bodies such as the Interstate Sanitation Commission to present the detailed facts and show the taxpayer in understandable terms the value of a sound solution.

Now let us turn to an area where, under the vigorous leadership of the New Jersey State Department of Health



LOADING BARGE WITH SLUDGE FOR DISPOSAL AT SEA,

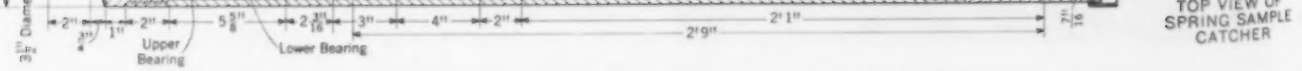
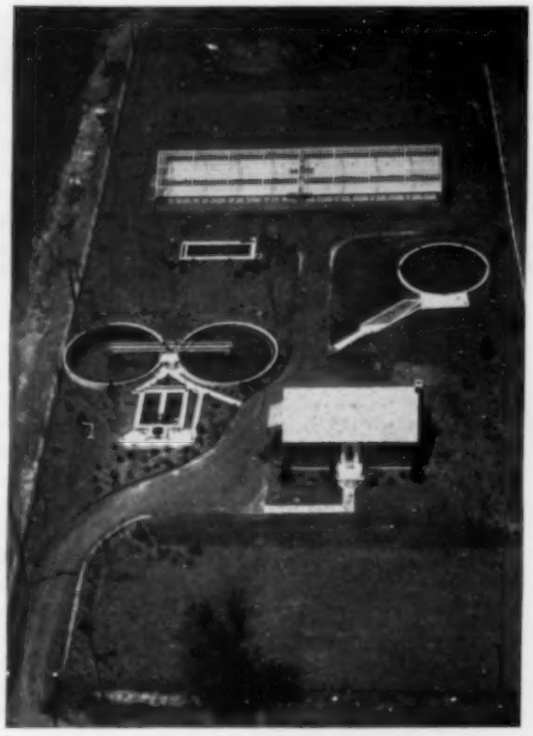


FIG. 2. DETAILS OF INSIDE-VENTING SAMPLER DEVELOPED ON THE DENISON PROJECT

and with the cooperation of the Federal Administration of Public Works, outstanding progress has been made in pollution abatement. In the past five years 17 sewage treatment plants have been constructed and placed in operation in the Raritan Valley, providing treatment for practically all municipal sewage and a substantial quantity of industrial waste (Fig. 3). The details of this program have been reported elsewhere, but I should like here to point out a few characteristics of the work that may be helpful in the solution of other problems within the Interstate District.

In the late twenties an intensive campaign of education and persuasion failed to bring about action on the part of municipalities, and the State Department of Health was forced to proceed through the courts. The Department was upheld in every instance and the municipalities were ordered to abate. However, these orders remained legal verbiage, as they were caught up in other legal verbiage limiting the indebtedness of municipalities. It remained for the Public Works Administration through its loans and grants to translate these orders into action.



THE SEWAGE TREATMENT PLANT FOR MIDDLESEX BOROUGH IS ONE OF 17 BUILT IN THE RARITAN VALLEY IN THE LAST 5 YEARS

Action resulted in each municipality's constructing its own plant at a cost substantially in excess of what was technically feasible by joint action for logical service areas. In spite of the sorry financial plight of municipalities, these obvious economies were sacrificed in the interests of completely independent action. Can we afford the extravagance of this extreme in local independence? The free expression of intelligent local self-interest is a fundamental principle in American democracy and it is to be encouraged and revived. But if we are to solve the many complex problems of an urbanized technological society within reasonable cost to the people, it is essential that all divisions of government cooperate. Cooperation and intelligent local self-interest are not mutually exclusive; one complements the other. In fact, successful prosecution of joint endeavors in the interests of the people is the essence of the democratic way.

A program of pollution abatement to be complete must consider the wastes of industry just as realistically as the sewage of municipalities. Industrial pollution and municipal pollution are not independent, mutually exclusive problems; to consider them so is to double the task of abatement and delay the attainment of clean streams. In many localities so-called municipal pollution contains large quantities of so-called industrial pollution, and it is logically considered one and the same thing, collected and successfully treated together. True, certain industrial wastes complicate treatment, but these exceptions should not hinder the effort to seek the simplest and least expensive solution by putting the industrial waste into the municipal systems wherever feasible.

In the Raritan Valley, although the municipalities failed to avail themselves of the advantages of reasonable joint action, there was striking evidence of cooperation between industry and government. Much of the industrial waste was included for treatment in the new municipal works constructed, and now the State Department of Health is vigorously engaged in bringing about further integration and pressing for independent treatment works for isolated industries. In abatement of pollution, industrial as well as municipal, by a drainage area as a whole, the Raritan Valley program is the outstanding achievement in the entire District, and it is anticipated that by 1941 the full return from a large expenditure of funds and effort will be realized in the rich utility of a clean water resource.

In turning to Newark Bay and its tributaries, we find that the pollution problem has grown in magnitude and complexity. Progress toward an ultimate solution in this area is about intermediate between that in the Hudson and that in the Raritan; some provisions for abatement have already been made, but the major portion of the work remains to be done.

This third subdivision west of the Hudson in turn divides itself into three sub-areas—the Passaic, the Kills, and the Hackensack—as shown in Fig. 2. In this region four regulatory agencies—the State Department of Health, the Passaic Valley Sewerage Commission, the Hackensack River Sewerage Authority, and the Interstate Sanitation Commission—exercise limited and overlapping jurisdiction.

The Passaic Valley Sewerage Commission has complete control over the Passaic River drainage area and operates an extensive system of trunk sewers along the river and a primary treatment plant located on Newark Bay with its outlet in Upper New York Bay near Robbins Reef. This system serves a population of over a million, including Paterson and a large part of Newark, and a substantial industrial load. The interceptor along the Passaic has improved that tributary from the status of an open sewer to that of a fairly clean river, which enters the Interstate District in substantially better condition than the water of Newark Bay into which it discharges. This, however, does not wholly dispose of the pollution problem

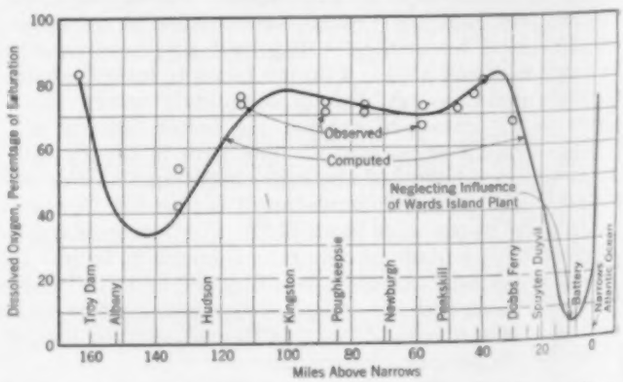


FIG. 1. DISSOLVED OXYGEN PROFILE OF HUDSON RIVER, LOW SUMMER RUNOFF

combinations present themselves.

In Fig. 2 are shown the areas along the lower west bank, where, as across the river in New York, little if any

LOADING BARGE WITH SLUDGE FOR DISPOSAL AT SEA, ELIZABETH, N.J.

from the drainage area, as the effluent from the treatment works still remains a factor in the condition of Upper New York Bay. The placing of the outlet in these waters was the subject of a very bitter dispute between New York and New Jersey, in which the courts decided in favor of New Jersey. As an aftermath of this dispute, when the Interstate Sanitation Commission was created, the Passaic Valley Sewerage Commission was exempted from any jurisdiction by the interstate body. Legally, therefore, the Passaic Valley problem is solved; actually, however, the residual pollution not removed by plain sedimentation remains as a debt to be met by the waters of the Upper Bay.

THE ELIZABETH VALLEY PROJECT

To the south is the area that I have designated as the Kills. In this region, with the aid of the Federal Administration of Public Works, two large joint undertakings have recently been completed and placed in operation. The Elizabeth Valley project serves a population of about 300,000 residing in 12 municipalities, and includes an extensive system of interceptors and a primary treatment plant discharging into the Arthur Kill near Goethals Bridge. The Rahway Valley project serves a population of about 70,000 residing in 8 municipalities, and includes interceptors and a primary treatment works discharging into the Rahway River about 3 miles above its confluence with the Arthur Kill. With the exception of the larger part of the city of Elizabeth (which is not connected to the Elizabeth Valley works), Linden, Carteret, and portions of Woodbridge, the New Jersey municipalities in this area have made definite progress in the abatement of the gross pollution of the Kills.

Helpful as these works are, the Arthur Kill during the summer is below the standards set by the Interstate Sanitation Commission. Sections of it are still practically devoid of dissolved oxygen. This is understandable, as the Kills are virtually lined with large industries, such as oil refineries, and chemical and metal works, which discharge large quantities of wastes. Furthermore, the natural stream assets are very small, for the Kills are virtually oscillating, stagnant pools in which the tidal changes produce but a slight net movement toward Newark Bay. The Kills cannot be expected to be more than a black sewer until the problem of industrial waste is vigorously attacked. More knowledge concerning the volume and strength of wastes from industries in this area would be an aid in determining the degree of treatment necessary to produce a stream condition consistent with the Commission's standard.

The Hackensack district, comprising the natural drainage area of the Hackensack River and the east shed of Newark Bay, includes a highly developed patchwork of over 50 municipalities and a number of large

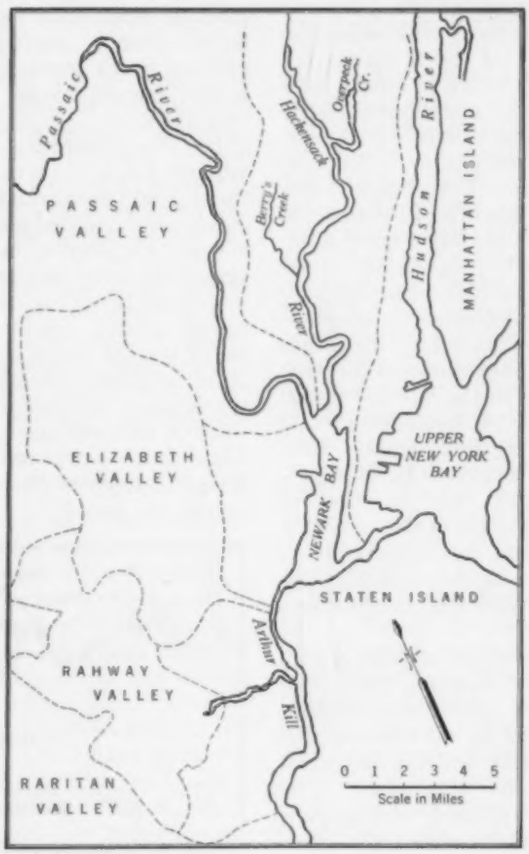


FIG. 2. AREAS WEST OF HUDSON RIVER WHERE LITTLE OR NO SEWAGE TREATMENT IS PROVIDED

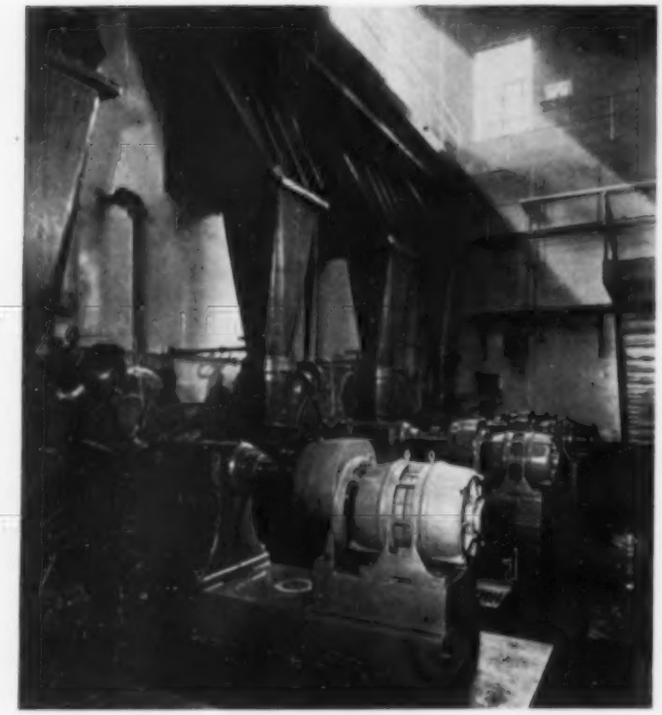
SLUDGE-DRYING BEDS AT BOUND BROOK, N.J.

industries. The solution of the pollution problem in this area is one of the major tasks confronting the Interstate Sanitation Commission.

Following a campaign by the State Department of Health to enforce pollution abatement in the valley, and recommendations of a commission authorized by the legislature in 1930 to study and report on the situation, the State Legislature in 1933 created the Hackensack River Sewerage Authority to manage pollution abatement in the drainage area. The Authority was empowered to buy and sell, construct and operate sewers and treatment works, and to issue bonds payable from revenues derived from municipalities and industries using the Authority's works. Such high hopes were placed in the Authority that court actions instituted by the State Department of Health, similar to those employed in the Raritan Valley, were held in abeyance in anticipation of action by the new Authority.

Immediately upon appointment of members of the Authority, an application based upon the report of the Commission in 1931 was filed with the Public Works Administration for a loan and grant of $23,600,000 for a system of interceptors for the entire valley and two large joint treatment works. The application was denied, largely because of inadequate security for the bonds; this security was based solely on the ability of the Authority successfully to enter into contracts for services to the many municipalities and industries in the area, some of which already had some investment in treatment works. No action resulted, and under a provision in the act which required construction to commence by January 1938, the Authority virtually lost its powers on that date.

With the rejection of the application by the Public



SEWAGE PUMPS IN THE RAHWAY (N.J.) PLANT
Plant, with 4 Pumps of 14-Mgd Capacity and One of 7-Mgd Provides for 12-Mgd Average Flow and 63-Mgd Storm Flow

Works Administration, the State Department of Health again began to apply pressure on the individual municipalities to construct works. This resulted in a number of communities' filing independent applications with the PWA. An effort was then made by those sponsoring the Authority to salvage some features of the original plan by introducing modifying legislation which provided for a separate approach by Bergen County, independent of the lower district in Hudson County, but this failed to pass. In 1939 a revised bill was introduced, now before the legislature, to reestablish the powers of the Hackensack River Sewerage Authority with modifications intended to improve financing procedure and to permit a more modest approach by smaller districts within the valley.

In the meantime, in considering the individual applications filed, the Public Works Administration, in cooperation with the municipalities, made an effort to obtain joint action in small groups by means of the joint meeting procedure similar to that employed in the Elizabeth and Rahway valleys. Two joint projects crystallized—one on Berry's Creek (Fig. 2) involving Rutherford, East Rutherford, and Carlstad, which was successful in organizing in time to receive a PWA grant; and the other on Overpeck Creek, involving 7 or 8 municipalities and a private sewer company, which was not successful in meeting the deadline. In addition to this, Hackensack and four smaller communities constructed independent works or extended existing plants.

These hasty efforts, taking advantage of federal aid, represent concrete advances. But nothing has been accomplished within the Interstate Sanitation District in Hudson County; much remains to be done in the upper valley tributary to the District; and the industrial waste problem remains practically untouched. The situation is at present somewhat confused, and in view of the financial plight of most municipalities the prospects for further immediate action are not encouraging unless some federal or state aid is obtained.

This brief survey of the sewage treatment problems west of the Hudson may be summarized as follows:

1. The people west of the Hudson are not unmindful of the problem of pollution of the metropolitan waters; in fact, they have been struggling with it for a number of years and through the efforts of the New Jersey State Department of Health and financial aid of the Public Works Administration can report substantial progress in certain areas.
2. It must be obvious to any thoughtful person that if pollution abatement is to be accomplished within a reasonable cost it must be approached cooperatively, with joint action among municipalities in logical service areas.
3. If full realization of clean, useful streams is to be attained and maintained it is imperative that we consider all pollution, industrial sources as well as municipal, and that for efficiency and economy, wherever possible, cooperation should be simultaneously developed between industries and municipalities for integrated action.
4. The inequalities in local tax burdens and borrowing capacity preclude any possibility of coordinated action which is dependent exclusively on local financing. The removal of limits of bonded indebtedness is not an ultimate solution. An actual shift in the tax burden to units of government better able to bear it is imperative. The record of PWA has demonstrated the value of the federal grant-in-aid as a stimulus to action and a relief to the overburdened local financial structure. The continuation of the grant-in-aid principle is important to pollution abatement work, and it might well be extended to include state aid. However, in order to insure economy and good planning, grant allotments should be made on the basis of reasonable costs rather than on unlimited actual costs. There is a temptation to become reckless when spending other people's money, and therefore the grant base should, if anything, err on the side of conservatism. Such a basis of computing grants would call for much more thorough preliminary planning and would reward sound engineering and economical construction.
5. Plans and procedures are as effective as the public support back of them. With the power to order abatement goes the responsibility to inform the public before funds are expended what can be expected from the investment. Detailed economic studies of every feasible plan should be fully carried out and presented to the people, including financing costs and operating costs as well as initial outlay. Such studies might well include an analysis of stream assets and liabilities in relation to stream standards and an evaluation of the effects of various plans upon the streams in order to show the taxpayers what is actually needed before they spend their money. There is no better way to gain public confidence and intelligent support than by continually placing the facts before the people.

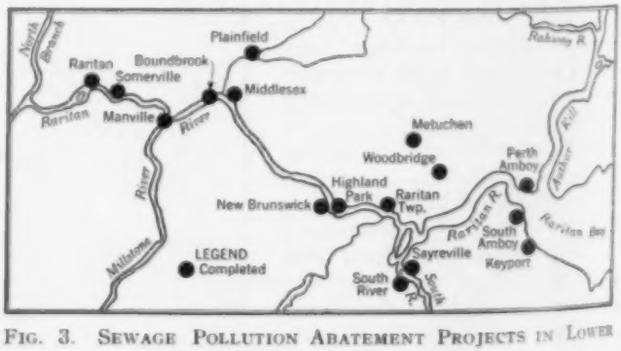


FIG. 3. SEWAGE POLLUTION ABATEMENT PROJECTS IN LOWER RARITAN VALLEY, NEW JERSEY

includes a highly developed patchwork of over 50 municipalities and a number of large

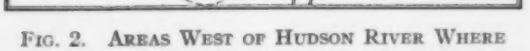


FIG. 2. AREAS WEST OF HUDSON RIVER WHERE LITTLE OR NO SEWAGE TREATMENT IS PROVIDED

lost its powers on that date.

With the rejection of the application by the Public

The Engineer and the Budget

A Specialist Gives Some Advice on How to Triumph Over, Instead of Succumbing to, This Familiar Financial Problem

FROM A PAPER ORIGINALLY PRESENTED BEFORE THE MICHIGAN LOCAL SECTION

By GEORGE R. THOMPSON

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

CITY ENGINEER, DETROIT, MICH.

Among many pertinent comments on this very pertinent subject, Mr. Thompson mentions the present widespread tendency in government financing to put the cart before the horse—that is, to determine how much money is to be spent before determining how much there is to spend. "Thus," he says, "we arrive at the theory of government by deficit." The first logical step in budget making, therefore, is to determine how much money is available for total governmental expenditures. The second step is to make an estimate of necessary outlay. Then, when the budget has passed through due legislative procedure and become a law, there is the problem of keeping within it. Mr. Thompson clearly analyzes the reasons why the engineer has his troubles with budgets, but, on the other hand, gives some very good reasons why the engineer is especially well fitted to make budgets and to carry them out.

AT first glance the subject, "The Engineer and the Budget," suggests the engineer versus the budget, in the sense that as a requesting agency the engineer has his troubles with budgets. He does not have much trouble keeping within a budget, but some engineers have a feeling that the making of a budget is a great hardship, and that they usually emerge from a budget conference somewhat the worse for wear.

Experience as state budget director for about ten years leads me to believe that this is not generally the case. Unfortunately, the average engineer is an extremely poor salesman, even of the services which he unselfishly wishes to perform for others. Unconsciously he takes pride in being a rather stubborn, uncompromising sort of person. This is probably because he generally knows what he is talking about and is inclined to make little allowance for the fact that the layman does not always understand his technical language. Furthermore, the engineer is a man of few words. A good salesman, although not necessarily garrulous, does not hesitate to use enough words to convey his idea to another person who has insufficient understanding of the matter under consideration.

The engineer will have little difficulty with budget making if he will prepare his budget requests in full detail—that is, gather the facts, present them in understandable language and logical sequence, and express them in terms of dollars and cents. Having done his part intelligently and forcefully, his responsibility for consequences ceases.

THE BUDGET VERSUS THE ENGINEER

So much for the subject interpreted as "The Engineer Versus the Budget." Now, to be strictly impartial, let us consider it as "The Budget Versus the Engineer."

The engineer is the proper advocate of major capital expenditures in government. This was especially true in the past when capital outlays for buildings, bridges, and other improvements constituted a larger percentage of public expenditures than they do now. At the present time such outlays have been necessarily curtailed to provide for new types of expenditure demanded by social agencies, such as those for education, welfare, and public health. The engineer's opinion has often been a deciding factor in causing large expenditures for construction purposes. His requests were of grave importance in governmental budget making. Frequently these requests were for such major initial outlays that the capital had to be supplied on a debt, instead of a cash, basis. This accumulated government debt, which is not due primarily to the engineer, but in the creation of which he was a participant, constituted about the "third strike" on him when he came up for a budget hearing. The engineer was often a major threat to the budget director.

So much for "The Budget Versus the Engineer." Now let us consider the subject from a more general point of view—the engineer and the budget working harmoniously for the public good.

"Budget" is derived from the French term *bouget*, meaning a purse, which later became identified with the king's or the state's purse. In view of some modern misconceptions, I like to think of the budget as a purse containing money which is allotted to various specific items of public expenditure—a purse perhaps with many small compartments, in each of which is a definite fund to be spent by the government. According to this conception of the budget, it is to be noted, the horse is logically placed before the cart; in other words, we have the money before we start to spend it. This is at considerable variance with another and more modern conception of the budget, according to which the cart is placed before the horse; that is, we determine how much money we should spend before we have it. Thus it is not to be wondered at that we arrive at the theory of government by deficit.

The first logical step, then, in making up a budget is to determine how much money is available for total governmental expenditures. To make more money available than is in sight at the time of preparing the budget is a matter of general governmental policy, in the field of taxation rather than in the specific field of budgeting.

Following the first phase of budget making, which is the estimate of available revenues, comes the second phase, which is the estimate of necessary expenditures. Government has now become "big business" in the sense that it is no longer devoted solely to the protection of life and property through various old and comparatively simple agencies, but has entered the broad field of the social and economic life of citizens. This process got under way slowly in the past but is proceeding rapidly in the present. No doubt the change has been a necessary evolution and not in any sense a revolution. However, it has turned government into a big business of the

pects for further immediate action are not encouraging unless some federal or state aid is obtained.

FIG. 3. SEWAGE POLLUTION ABATEMENT PROJECTS IN LOWER RARITAN VALLEY, NEW JERSEY

most varied and complicated kind, ranging in function from the inspection of bees to the operation of institutions of higher learning.

Because of the wide range of the activities of government, no one person can make an independent estimate of the cost of all these activities. However, he can, by consulting specialists in each field, and by comparing past expenditures with probable future needs, arrive at a reasonably accurate estimate even for the most highly specialized fields.

The use of the term "necessary" to characterize expenditures is comparative, for need is not a fixed quantity, and is always colored by what one can afford.

We have said, then, that the budget is comprised of two principal steps—an estimate of revenues and an estimate of expenditures. If it is to balance, these two must be equal. Otherwise there is either a surplus, which should generally be reflected in reduced taxes, or a deficit, which is limited by direct or indirect borrowing.

CARE NEEDED IN PREDICTING FUTURE GROWTH

In the Michigan state government the budget covers a two-year period, beginning six months after it is prepared. This calls for considerable care in predicting future growth and price levels. Long-range planning, for a ten-year or even longer period, is essential in weighing expenditures for capital outlay and improvement.

After the budget has been prepared and has passed through administrative and legislative analyses, it emerges as a somewhat familiar document in the form of a law which appropriates money and limits expenditures. The budget director has then performed the simplest part of his task. From the beginning of the fiscal period covered by the budget to the end of that period is the difficult part of budget directing, i.e., that of keeping the necessary functions of government within their allotted funds—in other words, keeping the budget balanced.

There is nothing new in the idea of a budget, as note the following from *David Copperfield:*

" 'My other piece of advice, Copperfield,' said Mr. Micawber, 'you know. Annual income twenty pounds, annual expenditure nineteen six, result happiness. Annual income twenty pounds, annual expenditure twenty pound, ought and six, result misery. The blossom is blighted, the leaf is withered, the God of day goes down upon the dreary scene, and—and in short you are forever floored.' "

THE ENGINEER'S QUALIFICATIONS FOR BUDGET MAKING

And now let me return to the engineer's relation to the budget. There is an appropriate logical association between the engineer and the budget as regards the engineer's qualifications for budget making and operation.

1. The engineer's first qualification is that by training and experience he has what is termed the scientific approach to the solution of any problem. He is essentially a fact finder and is not easily led into substituting wishes for facts. Wishful thinking is not conducive to sound financing.

2. The engineer is trained in mathematics rather than in accounting. To him, figures are an alphabet with which to tell a story or express an idea in precise language. They are a tool of his profession and not its aim. While he has, or should have, a basic knowledge of accounting, he does not concede it to be an end in itself. Like words and language, figures and their relationship to each other must be simple, clear, and coherent, if they are to convey an idea or tell a story. Terms must be defined. A cash statement is one thing and an encumbrance statement is another. Revenue differs from receipts. Assets may be weighed against liabilities, provided judgment is applied in evaluating the probabilities of each.

SOME "SIMPLE" QUESTIONS ARE HARD TO ANSWER

I have been asked such simple questions as, How much does the state receive and how much does it spend? I find it impossible to give a safe answer without qualifications. This question was confusing because the terms "received" and "expended" were not clearly defined in the questionnaire. Another innocent question which undoubtedly deserves a straightforward and simple answer is, How much did the state government cost last year? The confusion in answering such a question arises from the fact that the term "state government" is not defined.

3. The engineer is accustomed to making cost analyses and to breaking down problems of cost into monetary or other units. Unit costs are as fundamental to the making of a budget as bricks are to the building of a wall.

4. An engineer acquires the ability to judge values received in both services and materials. This sense of weighing and evaluating returns for money expended is essential in determining what are necessary expenditures.

5. An engineer knows people of all kinds and descriptions. He is accustomed to dealing with those of high and low degree. Since government is "of the people, by the people, and for the people," its expenditures are for the good of the people and its money comes from the people. Making an operating budget for government is the most human job in the state.

6. An engineer is accustomed to handling money as one of the elements of his work. Furthermore, he is accustomed to handling other people's money—rapidly, carefully, honestly, and in large quantities with no alibis. He realizes the necessity of getting one's money's worth out of the tax dollar as fully as any group or profession in the country.

Incidentally, money is only a symbol of buying power. We call the dollar a unit of value because it is the only unit we have developed so far. Compared with the mathematical units such as the gallon, the meter, and the ounce, it is a poor standard because of its great variation, but it is the best we have and I would be a poor workman to quarrel with my tools.

7. An engineer must have imagination, or he never could design. Every engineering structure built was at one time a picture in the designer's mind. Every estimate, likewise, calls for a certain amount of logical imagining. While the engineer may exercise his imagination in these directions he does not let it run away with him. He can dream and not make dreams his master. In fact, his imagination is so keen that he can imagine mistakes in his own estimates, and therefore, quite logically to his way of thinking, he puts in an item called contingencies, factor of safety, or some other phrase that provides for his ignorance, but not lack of intelligence, in predicting the future. In that prediction there are two possible sources of error, error in estimating income, and error in estimating outgo, and these errors do not compensate for each other.

It would have been possible to take another view of the subject and consider the engineer as the party requesting funds from a budget, but this is probably of less moment. Enough has been said to buttress the claim that the engineer can, if he will use his natural abilities, successfully cope with the many difficulties of the budget.

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ever, it has turned government into a big business of the

An Engineer's Reminiscences of the Southwest

Experiences of a Half Century Ago Stress Realistic Side of Pioneer Life

By C. Frank Allen

Honorary Member American Society of Civil Engineers
Professor Emeritus, Massachusetts Institute of Technology, Cambridge, Mass.

My first contact with the American Society of Civil Engineers was in April 1877, at the convention in New Orleans, to which I was invited with other members of the Boston Society of Civil Engineers. Those were the halcyon days before the Interstate Commerce Act robbed some of us of our joys. We rode to the convention on free passes and in part on special trains. Arrived at New Orleans, we failed to be granted the freedom of the city, as there were two governors (at least claimants) and some of the streets were barricaded and fortified. This was in reconstruction days. However, we had no fault to find with the welcome given us by our hosts the engineers.

The favorable opinion of the Society which I formed from attending this convention led me to join it in the grade of Member early in the next year, that is, as soon as I became eligible. The requirements then were seven years of engineering practice, two of them in responsible charge. In my case two years were credited to my graduation from the Massachusetts Institute of Technology. I was then twenty-six years of age. I was not interested in the grade of Junior or Affiliate, and the grade of Associate Member was not added until some years later. The grade of Member now requires twelve years of practice, responsible charge for five years, an allowance for graduation of four years, and an age limit of thirty-five. This shows only one phase of the development of the Society; there are many others.

The next convention was held in Boston, and the highlight was a trip to the White Mountains, by special train, of course. The new rack-railway up Mt. Washington, the first of its kind in the world, was a feature of prime interest. The rack-rail was composed of two angle irons, with rounds of iron or steel between. In the course of a discussion, some of the most active members of the Society predicted that some day one round would break, that the blow taken by the next round would strip it, and so away down the line. Some time later one round did break, but the next held. Forecasts are dangerous. Whatever methods the workmen had of reaching the top of Mt. Washington, their choice in descent was in their own hands and in the nature of a frolic apparently. As shown by a photograph, the style of locomotion somewhat antedates, and transcends, the modern "soap-box derby" with which it has certain features in common.

Workmen Chose a Unique Method of Descending Mt. Washington, New Hampshire

To go back to my college days, my professor of civil engineering at Tech was J. B. Henck, whose Field Book was the standard for many years. He was a fine mathematician, a thorough teacher, and a most careful surveyor. His use of a spring balance and a thermometer in staking out the filled lands of the Back Bay in Boston was sufficiently unusual to excite our interest—so much so that one irreverent student suggested that he corrected even his pacing for temperature.

Early Work in the East

Immediately after graduation, I had my first employment in engineering construction in Providence, R.I., where the introduction of water works was in progress, my duties being connected with pipe laying and later with sewer construction, which quickly followed under the same engineering head. When some of the contractors engaged in the sewer construction threw up the job upon meeting unexpected difficulties, it seemed wise to undertake some of the work by newly organized city gangs. In difficult work, the skill—almost genius—of the engineer in charge resulted in economy. But in simple, straight work, which was sometimes found necessary to keep the gang going, the city could not compete with the contractors. The laborer displayed less energy for the city than for the contractor, especially when the latter was looking on. The city never looked on.

At this time, long before trench machines or steam shovels were used in ditch digging, the material in the bottom was cast up to a platform or stage above, again to the top of the trench, and again to a bank alongside. At one time, with some craftiness, the men in the bottom were paid by the cubic foot at a price profitable to them if they were energetic, as well as to the city. The laborers worked hard. So did the men on the stages above, in order to hold their own—but they were paid by the day.

The sewer manholes curved in plan and also in vertical section were found by local bricklayers to be difficult to construct. Men were imported from Brooklyn, N.Y., and paid the unheard-of wage of seven dollars for a day of ten hours. But that was more than sixty years ago.

During my employment in Providence, I was sent to Akron, Ohio, to inspect, before shipment, the salt-glazed sewer pipes manufactured there. A two-week vacation allowed me to obtain a wider view of the West.

After four years in Providence, I was called to take charge of construction of the open-air reservoir at Newton, Mass. The material was hardpan and the

Terms must be defined. A cash statement is one thing the budget.

NOTED HANGING BRIDGE IN THE ROYAL GORGE, GRAND CANYON OF THE ARKANSAS

Showing Novel Support of Outside Girder from Struts Overhead

method of excavation was to cut under a face at floor level, and then, encouraged by crowbars at the top, to topple over a narrow section. In the fall the hardpan was pretty well broken up, requiring comparatively little pick-and-shovel work afterwards. Steam shovels for such work had not come into use at that time. Selected material, well watered and rolled, made a puddle wall in the middle of the bank, and this proved effective. In the accompanying view the excavation is all but completed.

A year later found me in charge of the extension of the "filter basin" of the Newton water works, located at the water's edge, alongside the Charles River. During construction it became evident to us that practically all the water came from the land side and that the "filter basin" was in fact an elongated shallow well, its water table higher than the surface of the river. This fact had shortly before been established as the outcome of a lawsuit against another city taking water from the same river.

This point of view was somewhat confirmed by an interesting sequel. It was discovered that the ground water exposed to light and air developed algae. The "filter basin" was then narrowed, covered, and extensions were made by means of driven wells. A covered reservoir was built advantageously at a higher elevation to replace the older one, which was acquired by the Metropolitan Water Supply, a river supply. All this is an old story to engineers now, but at that time it was a new idea in water supply engineering.

Not so long after the completion of this work it developed that projects apparently headed my way dropped out owing to an extended depression. I had seen something of the West and travel was not new to me, so I soon found myself in Pueblo, Colo., the engineering headquarters of the Santa Fe Railroad. While waiting for an anticipated job, I spent a few days in an engineering camp in the Grand Canyon of the Arkansas; the division engineer there was a friend of mine. This division included the Royal Gorge where the channel was so narrow that it was decided that no obstruction could be tolerated, not even the debris from blasting out a roadbed. The solution lay in hanging one girder of a bridge over midstream, the two struts for the hanger easily reaching the rocky sides of the narrow gorge, creating the "hanging bridge."

REAL WAR OVER A RAIL ROUTE IN THE SOUTHWEST

After a few days I was called to Pueblo, where my draftsman's job was awaiting me. My first duty was to sketch the fortifications of the Denver and Rio Grande Railway at South Pueblo; for actual warfare was being waged for the possession of the line through the Grand Canyon. There was war to the extent of some bloodshed. Not long after, I was sent to Las Vegas, N.Mex. At this time trains had to cross the Raton Mountains by a switchback, while the tunnel was under construction.

Before I left Pueblo, there was a public execution on the open plains—a legal execution by hanging. It did not interest me. I worked in the office alone. An execution of a different sort occurred during the time I was in New Mexico. A Navajo Indian, civilized—that is, drunk—playfully threw a lasso over a quiet individual returning from market one Saturday evening. Somebody took a shot at the Indian, so that he cut the rope, put spurs to his horse, and got away. When he was captured the next day, the rope matched. The citizens strongly disapproved of the Indian's act; however, with great self restraint, they let the Sabbath run by; but on the stroke of twelve, they opened the jail and carried out their purpose. When I arrived from the south at six o'clock in the morning on Monday, the lifeless body of the Indian was dangling from a telegraph pole in the railroad yard, unattended.

During my stay in Las Vegas, I had a chance to see a procession of the Penitentes, a fanatic religious order with a considerable membership. One or two of the members were flaying their bare and bleeding backs with scourges of cactus thorns, while another was laboring under a ponderous cross. These rites were carried on sometimes to the extent of loss of life.

The burro (Mexican synonym for jackass) is much of an institution in New Mexico. With his pack of firewood, he may be seen in almost any Mexican village. Many of the houses or huts have a corner fireplace where the sticks can be set up on end, forming a sort of cone with a fine up-draft through the fagots.

CONSTRUCTING RESERVOIR AT NEWTON, MASS., IN 1877

One day, in our travels, we saw an aged Mexican, burro-back, digging his hard heels into the beast's ribs while he belabored his flanks with a creditable cudgel, thereby securing a gait of perhaps four miles an hour. Along came a stagecoach and four, and the burro kept up for several miles. It was hardly ambition, rather just plain sociability.

There was a saying there that a white man and a horse, a darky and a mule, a Mexican and a burro, were well mated. There was again a proverb that when a young Mexican had a borrowed horse and his own spurs, something was likely to happen.

During my stay in New Mexico, I was put in engineering charge of construction of a short railroad line from Las Vegas to Hot Springs, and also, in private practice, served as chief engineer in the work of introducing water into Las Vegas.

SOME EXPERIENCES AS RIGHT-OF-WAY AGENT

Later I was assigned to a non-engineering job in settling right of way for the Santa Fe Railroad in New Mexico. In this connection I was in contact with the older civilization growing out of the Spanish occupation. Santa Fe is the second oldest city in the United States. One old church there is more than three hundred years old, built of adobe mud—that is, mud mixed with straw, biblical fashion, and baked in the sun. The buildings are plastered with the same kind of mud. Being little

ELEPHANT BUTTE DAM ON THE RIO GRANDE
ABOVE EL PASO, TEX.

exposed to rain with frost following, its coating does not suffer much, and a little adobe plaster rubbed in with the palm of the hand preserves the surface. This plastering is women's work, they told us. The oldest house in the United States is in Santa Fe. Bricks mixed with straw look like an ancient prototype of an early form of reinforced concrete, in which the metal was employed merely as a binder.

My principal field as right-of-way agent was along the fertile lands of the Rio Grande Valley. Here, possession and use constituted title, no written deeds or wills having been in use probably for a century or two. The owners, small farmers, natives, were mainly of mixed blood—Spanish and Indian.

These people have an innate politeness of which most of us know nothing—together with a fine spirit of hospitality and something akin to pride. They are dilatory and, in the lower classes, capable of minor peccadillos, but apparently in some phases of honesty or honor not our inferiors. Those of our own people who came with the railroad to the frontier were largely abrupt, arrogant, energetic, so that there was little of sympathy between

A MEXICAN WOOD TRAIN NEAR BELLEN, N.MEX.
Typical Adobe Construction in Background

the two classes. My interpreter, a native of Detroit but long a resident of New Mexico, knew the people thoroughly, so that I made few mistakes in dealing with them, acquired a liking for them, and was successful in securing their confidence. Most of them could neither read nor write. In one case, in deeding land to the railroad, the man signed with a cross, "his mark," and his wife likewise. It was polite—and politic—to use the justice of the peace in that village. He too signed with a cross.

During one season, the valley suffered from a run of smallpox, an event which occurred once in six or seven years, apparently when a fresh crop of young children was available. It was the custom there to expose the children to the disease deliberately, so that if death occurred, it took the children before too much affection and cost had been expended on them. Vaccination, except in a very few families or settlements, was quite unknown. In one village in the valley where there had been fifty children, only four or five survived. This was the worst sort of black smallpox, they said.

Some of the lands the railroad wished to acquire were on the Isleta Indian Reservation. The Isletas are Pueblo Indians, agriculturalists, and entirely peaceful. Some of them cultivate the Mission grape, from which an excellent wine is made. In the Zandia Pueblo, where the same Indian language is spoken, it happened more than sixty years ago that a governor who deplored the use of wine had every vine ripped out, an early case of effective prohibition. These two villages are a few miles below Albuquerque, now a thriving city, the largest in the state. But when I made my first visit there by stage coach from Las Vegas—the end of the railroad—there was an open plain where now the city of Albuquerque stands. On my return trip we learned that twenty-four hours earlier the coach had been held up by robbers.

BRANCHING OUT INTO THE LAW

In order to avoid building and maintaining two bridges, the Santa Fe Railroad changed the channel of the Rio Grande at one point, much shortening it and thereby affecting the levels of the water above and below. The irrigating ditches also were disarranged, with the result that nearly one hundred and fifty suits for damages were brought by the people, mainly small Mexican farmers. As I was familiar with conditions in the valley, understood the people, and had a very competent interpreter, it fell to my lot to make the necessary surveys and incidentally to shape the lines of defense, varying in four different communities. Thus for some time I was in close contact with the legal department. The outcome was that I was urged to study law further, was admitted

to the bar, and was assigned to the post of local attorney for the railroad at the small city of Socorro, where later I was also elected city attorney.

Once in Socorro I was assigned by the court to defend a little Mexican sheep herder charged with cattle stealing. He was acquitted, but I noticed that he seemed downcast as he walked away. He had been two or three months in jail and had never had so good a bed or so much to eat.

On one of my trips to New Mexico several years ago, I happened to see laid a bit of the foundation of the Elephant Butte Dam which, in the interest of irrigation, backs up the Rio Grande for some 46 miles. The dam is

FILTER BASIN FOR NEWTON (MASS.) WATER WORKS PARALLELS THE CHARLES RIVER

318 ft high. Cement was expensive there because of the heavy charge on long-distance freight, so it was found economical to install machinery to grind it finer and so make it stronger. About 65,000 bbl of cement were used.

Before this dam was built the river had carried quantities of silt over the fields, enriching them. The dam yielded an effluent so much clearer that some crops were not as well taken care of. Whether or not from this cause, alfalfa, which yields four crops a year, largely gave way to cotton, of which a very fine quality is grown in that part of the valley.

At the time of my first trip to El Paso, there were no bridges across the Rio Grande at that point. A rope ferry, with a scow big enough to carry vehicles, as well as passengers, took care of transportation across the river. When the scow was rigged diagonally to the flow of the stream, the current provided the power.

For a short time I was with the Mexican Central Railway south from El Paso. While in that section, I witnessed a cloudburst in which 7 in. fell in about two hours and a half. The average annual rainfall there probably was not more than 10 in. Another time, while traveling southward in a different region, we passed over a steel bridge of two spans, 130 ft each, beneath which not a drop of water was to be seen. On our return northward, perhaps two days later, we found that one of the abutments had been partly washed away.

At one point the railroad was constructed across the dry bed of a mountain stream in cut instead of fill. The arroyo, or stream in time of freshet, rushed down its steep bed carrying quantities of sand and gravel in suspension. Reaching the flat lands below, the velocity was checked and the gravel deposited, higher in the middle and petering out at the sides. Successive torrential flows had built up a high rounded mound, high enough to cover up a hut, built by some unwitting Mexican, which was uncovered by the railroad excavation.

During the time I was in El Paso, a locating party 50 to 100 miles to the south was wiped out by a band of Yaqui Indians on the war-path. Other hardships of engineers might be recorded. Once a carefully picked party was sent out for what might be called an instrumental reconnaissance west from Albuquerque. They returned, some of them wearing gunny sacks instead of shoes, reporting that at times although there was water to drink there was not enough for washing. There were occasions when railroading was not all joy in those days. The romantic side was not the only one.

Fifteen years after graduation, on a visit home to Boston, I accepted a position to teach at the Massachusetts Institute of Technology. I continued an active member of the faculty for 29 years.

My first term's work I have always counted a failure. I did all the work. If my demonstrations were clear, all the worse; no effort seemed necessary to the students. I learned my lesson in four months. I have reason to believe that many teachers still do too large a share of the work themselves. A former student reminded me at a football game that I had once told him a man did not grow strong by watching the players from the bleachers.

WHAT THE WELL-DRESSED ENGINEER LOOKED LIKE IN THE SEVENTIES—NEWTON (MASS.) RESERVOIR CONSTRUCTION

From its derivation, "e-duc-ation" means drawing or pulling out, not pouring in. Not every student can digest over much pouring in, and sometimes the cream rising to the top may overflow and be wasted, leaving largely dregs—which are not always lacking even in a professor's lecture. The aim should be to develop rather than instruct the student. Someone has said that it is not so important what you teach as how you teach it. One of my assistants, who had spent a year studying in Dresden, commented favorably on the well-prepared lectures given there but "missed the discussion," characterizing one of my courses.

The influence of the teacher is by no means confined to the classroom. It is almost appalling to realize at times what effect an apparently inconsequential remark or act has upon the student. But this is more or less "off side" as far as reminiscences are concerned.

Improving Mississippi River Navigation

Data Show Beneficial Effects of Cutoffs and Channel Work

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NO question now remains but that the Mississippi River cutoffs have materially lessened flood threats. But how have they affected navigation? In answering that question Mr. Clemens first discusses river traffic and its problems—also the piloting skill immortalized by Mark Twain and still at a premium on the river. Then he quotes extensive studies of barge running times and capacities before the cutoffs existed and afterwards, to show that upstream times for low and medium stages, and downstream times in general, have been reduced. This paper in more complete form was presented before the Waterways Division at the Society's Spring Meeting.

NAVIGATION on the Mississippi River has been one of the important factors affecting the development of the central portion of the United States. Early settlers carried their products down the river to New Orleans in flat-boats, sold their boats and cargo, and returned overland along the Old Natchez Trace. The advent of the steamboat brought the packet boat, which carried cotton and other products of the valley downstream and returned with manufactures from the East and abroad. The packet business was interrupted by the Civil War, when the Mississippi River became the scene of active naval operations. Much has been written of Admiral Porter who assisted the military activities there by operating a fleet of gunboats on the river. Following the war, the packet-boat business returned, reaching its peak in the late eighties. Then railroads took most of the business away from the packet boats and river commerce fell to one of its lowest points.

Shortly before 1920 there was a revival, and between 1920 and 1930 a very considerable increase occurred — using not the old-time packet boat but barges pushed by towboats—instead of pulled as in open-sea navigation. This method of river navigation has been further developed, and although perhaps lacking the glamour of the packets, has become an important element in the transportation system of the central valley.

Considering the river from Cairo, Ill., to New Orleans, the problem of navigation is that of moving loaded barges and boats through an open channel about 1,000 miles long. Towboats must have sufficient power to overcome the force of the current when traveling upstream and to guide their tow when traveling downstream. The total lift from New Orleans to Cairo is approximately 310 ft at high water and 270 ft at low water. Thus, the important factors affecting navigation are the velocity of the current, the distance to be traveled, and the lift to be accomplished. These must be maintained in such balance that vessels can proceed without serious interruption or undue delay.

The approved navigation project for the Mississippi River from Cairo to Baton Rouge, La., authorizes a channel 300 ft wide and 9 ft deep, to be maintained for open-river navigation by dredging and such other means as may be required. Below Baton Rouge, a 35-ft channel is maintained. Dredging was first attempted soon after levee construction was initiated at New Orleans. The record books tell us that the first levee was built in 1717 and the first dredging was carried on in 1726. General maintenance work up to about 1900 was confined largely to removal of major obstructions by snagging and intermittent dredging of the worst shoals. Beginning about 1900, the so-called self-propelled dust-pan dredge was developed. Its purpose was to open channels quickly at low water through bars formed during high stages. Spoil was placed as most convenient with no attempt to shape the high-water channel.

Hazards to navigation vary with the stage. At bank-full or high stages, bends are usually the most difficult to navigate; currents are swifter and if high banks are close together at a sharp bend there is very little opportunity for towboats to avoid the swift water in going upstream. At low water, the shoal crossings, with long shoal reaches or short bars crossing or projecting into the channel, present the principal difficulties. Channels may be narrow and crooked even though of project dimensions, and thus may present difficulties in maneuvering. This frequently requires what is termed "double-tripping," or dividing tows into two or more sections, to negotiate difficult reaches.

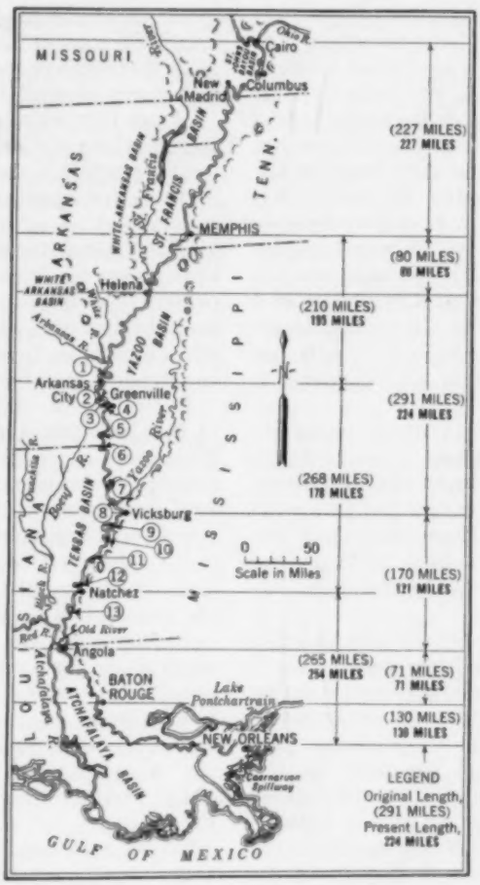


FIG. 1. MISSISSIPPI RIVER BELOW CAIRO, SHOWING CUTOFFS AND RIVER REACHES FOR NAVIGATION STUDIES

Stages vary throughout the year and show considerable deviation from year to year. The length of the flood period during which high-water difficulties may be expected ranges from zero up to more than four months. However, on the average for the 10 years from 1930 to 1939, the flow exceeded 1,000,000 cu ft per sec only 51 days per year at Vicksburg, Miss. Similarly, the low-water period with less than 150,000 cu ft per sec varies from zero to over three months each year, but has averaged only 35 days during the same 10 years. Thus high-water difficulties are only experienced about 15% of the time and low-water difficulties about 10%, leaving

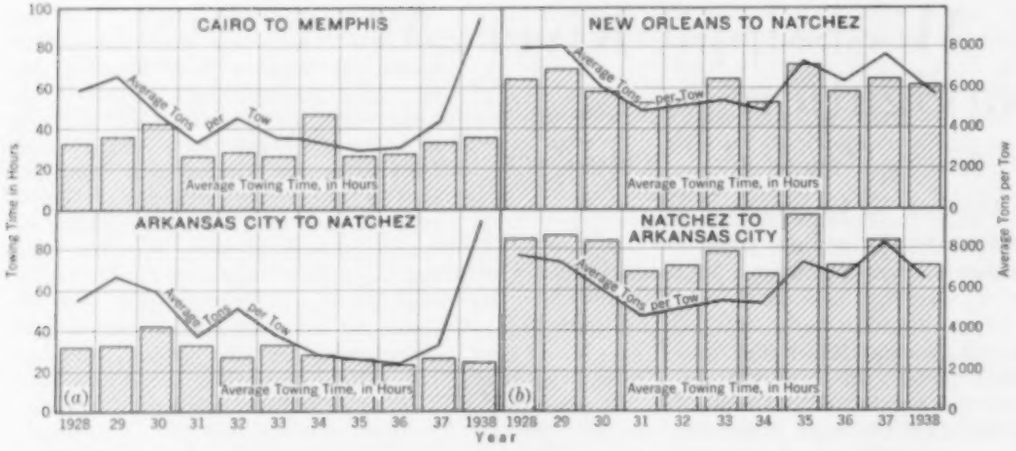


FIG. 2. TYPICAL TOWING DATA, FEDERAL BARGE LINE: (*a*) DOWNSTREAM, (*b*) UPSTREAM

some 75% of the time when the flow ranges between 150,000 and 1,000,000 cu ft per sec and favorable stages for navigation may be expected. The calendar year 1939 was a very unusual year in that both extreme periods were long—in all comprising over half of the year.

The first part of 1940 was unusual in that the ice obstructed navigation for about a three-week period during late January and early February. Temperatures fell far below normal all the way to the Gulf Coast and running ice was observed as far down as Plaquemine below Baton Rouge. At Caruthersville, Mo., where an ice jam built up a difference in head of several feet and entirely obstructed the river, one boat and tow were caught but escaped serious injury when the ice broke.

Velocities in the Mississippi range from less than 1 ft per sec to over 14 ft per sec at certain restricted sections in high floods. At low water, the swiftest velocity is at the shoals or crossings. Ordinary velocities range from 3 to 5 ft per sec, although velocities of from 5 to 7 ft per sec sometimes occur if the slope is exceptionally steep or the crossing narrow. As low-water depths are much less than high-water depths, the slope may become considerably greater without causing excessive low-water velocities. For example, slopes of 0.8 to 1 ft per mile are not uncommon at crossings at low water, and velocities of 4 to 5 ft per sec may be expected under these conditions. Under extreme conditions, slopes as high as $2^1/_2$ ft per mile have occurred, with velocities only a little over 6 ft per sec.

In bends, velocities at low water are normally low, frequently ranging from 1 to 2 ft per sec. As the stage rises, however, the slope in the bend increases, and owing to the greater depth, high-water velocities are produced that are much greater for the same slope than those encountered in crossings. Velocities of over 10 ft per sec have been observed in bends prior to the initiation of any cutoff work.

In towing operations upstream, it is generally possible to avoid the highest velocities. At high water, this is accomplished by leaving the deeper channel and running over the sand bars or in following chutes or side channels where velocities are low. It is in these operations that the skill, knowledge, and training of the pilot, as immortalized by Mark Twain, become vital factors in operation. The experienced pilot knows how to balance speed of current and distance to be traveled to obtain the maximum amount of general progress upstream in the least total time of travel. The inexperienced pilot can waste much time in following long channels when his boat would progress almost as rapidly through shorter channels with slightly increased velocities, or he may lose much time bucking the current in the main stream when more speed could be obtained by following slack water over the bars.

When traveling downstream, the reverse is true—the experienced pilot takes full advantage of the current to increase his downstream speed to the maximum consistent with the safe handling of his tow. It is obvious that towing time between terminals is not only a function of the slope, depth, fall, and velocity of the stream, but depends to a large extent upon the skill of the pilot in evaluating all these factors.

River commerce has shown a marked increase since 1930; new operating companies have initiated or extended their operations, and a considerable number of new towboats have been placed in service. For example, the Inland Waterways Corporation (Federal Barge Line) practically doubled both its upstream and downstream traffic between 1930 and 1938. Special movements of freight have also shown a material increase. The most notable of these is the upstream movement of petroleum products. The total traffic in this commodity increased from about 175,000 tons in 1926 to over 1,160,000 tons in 1938. During the period from 1935 to 1938 there has been a steady increase in the downstream movement of steel and steel products.

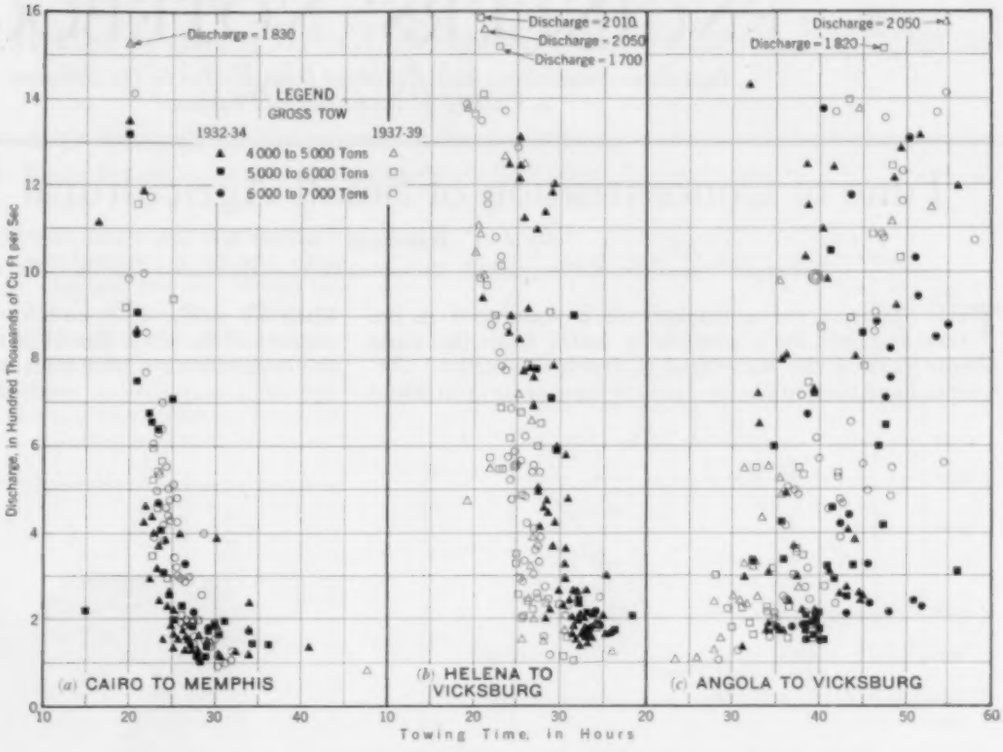
Many factors affect the increase or decrease in commerce along the river—competing railroads, changing world markets, and a variety of outside conditions. Suitable transportation units, towboats and barges, and satisfactory operating companies and schedules, as well as local terminal facilities, frequently have an important bearing on the business obtained. Years of high floods present special problems to navigation as do years of drought and unusually low water. Knowing this, proper allowance must be made for all these factors, in studying the changes that take place from year to year.

Beginning in 1932, there was initiated on that section of the Mississippi River between the Arkansas and the Red River a program of extensive channel improvement involving the construction of cutoffs and considerable work between cutoffs. The map (Fig. 1) shows the 13 cutoffs and the reaches of the river covered in our navigation studies. Although varying somewhat between high and low water, the total general shortening produced by the cutoffs has been somewhat over 120 miles.

Recognizing the uncertain character of theoretical analysis, a very exhaustive study has been made of the records of actual operation of a number of the principal towing units on the Lower Mississippi River. Masters' logs, operation reports, records of tow, and tonnage carried were obtained from the files of each individual company, and in some cases from the masters of the vessels themselves. In this way, the actual performance of different towboats was obtained. The period of operations considered extended from 1928 through 1939. The first artificial cutoff was opened in 1933, and the cutoffs began to affect the navigation channel materially by about 1935.

From the operation records, towing time was obtained by first determining the actual elapsed time and deducting therefrom delays, such as loss for fog, mechanical repairs, grounding, and fueling, which do not represent either the ability of the boat or the excellence of the channel. Double-tripping was included in towing time as well as time for breaking tow and remaking after double-tripping.

The entire stretch, therefore, from Cairo to New Orleans, was divided into sections corresponding to freight divisions (Fig. 1), and towing time in each section was determined. Cutoffs are included in two sections, the upper being extended to include Helena, the upstream limit of the cutoff effect, as determined by water-surface studies. Analyses of towing time were made in such a manner as to evaluate the influence of several factors such as size of tow and flow of the river. Upstream trips were summarized separately from downstream trips. It is impossible to present the large amount of information obtained; Figs. 2 and 3 give the general trend.


Discharge = 1 830
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Discharge = 1 820
LEGEND
GROSS TOW
1932-34
1937-39
4 000 to 5 000 Tons
5 000 to 6 000 Tons
6 000 to 7 000 Tons
Discharge, in Hundred Thousands of Cu Ft per Sec
(a) CAIRO TO MEMPHIS
(b) HELENA TO VICKSBURG
(c) ANGOLA TO VICKSBURG
Towing Time, in Hours

FIG. 3. AVERAGE TOWING EXPERIENCE, MISSISSIPPI VALLEY BARGE LINE
For Four Towboats with Various Tonnages and River Flows.
(*a*) and (*b*) Downstream Trips; (*c*) Upstream Trips

Federal Barge Line data covered towing operations from 1928 through 1938, including average towing times per tow in each year and cargo tonnages. Typical results are shown in Fig. 2. Obviously in downstream towing time (Fig. 2*a*) there has been a general decrease in the Arkansas City to Natchez reach—this in spite of a marked increase in loads. By comparison, in the Cairo to Memphis reach, unaffected by cutoffs, the general trend shows little change; the disparity for 1934 was due to a difficult channel condition that existed at Island 35 in the Memphis District in that year.

In comparing the upstream data (Fig. 2*b*), it is necessary to take years of approximately equivalent flows as well as of equal average tonnages, as the towing time varies with both these factors. Thus for the comparable years 1930 and 1938 over the New Orleans to Natchez reach—essentially below the cutoffs, where no great change would be anticipated—there was in fact no marked difference in towing time. Taking the same two years in the Natchez to Arkansas City reach, however, although the tonnage is again practically the same, there is a marked reduction in average towing time for the same cargo tonnage after the cutoffs were developed.

The Mississippi Valley Barge Line operates four similar towboats between New Orleans and Cincinnati. Details of about 400 trips in each direction between November 1931 and November 1939 were abstracted. For these studies the three charts of Fig. 3 give typical results for the two periods, 1932–1934 and 1937–1939, respectively, before and after the cutoffs were in operation.

In general Fig. 3(*a*) shows little change in the downstream towing time in the Cairo to Memphis reach. Over in the Helena to Vicksburg reach, Fig. (3*b*), in which are located about half the cutoffs, a decrease in towing time downstream is evident. Illustrative of upstream towing time, Fig. 3(*c*), Angola to Vicksburg, shows a definite trend at lower stages toward a reduction of towing time since the cutoffs became effective, with little change at higher stages, in the upper part of the chart.

Only a portion of the data are represented on Figs. 2 and 3. They, however, fortify the conclusion of the entire study that, on the whole, use of the cutoffs has reduced towing time both upstream and downstream.

Master's logs of various Standard Oil Company boats were also examined. These data supported the similar facts shown in Fig. 3. Generally, however, the results were much more uniform on the downstream counts and much more diverse on the upstream.

Records for other operating companies and other boats confirm these various conclusions. The Union Barge Line Company has successfully operated a boat of 350 hp in the Memphis to New Orleans reach. Other boats of medium power have shown generally reduced towing time for flows below 1,000,000 cu ft per sec both upstream and downstream in the Baton Rouge to Helena and the Helena to Baton Rouge reach during the years 1938 and 1939 as compared with 1935, 1936, and 1937.

From these studies of the records of several barge lines and private carriers, the general conclusion is that on a whole navigation has been improved in the reach of the Mississippi River from Arkansas River to Old River during the years 1932–1939. Upstream running time through the cutoff section has been materially reduced for low and medium stages. At high stages for heavy tows there has been some increase in running time. Downstream trips have generally been improved at all stages. The net result has been a net decrease in running time when consideration is given to the size of the tow and the stage of the river.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Time of Concentration of Small Agricultural Watersheds

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THE "time of concentration" of a watershed is the time required for a particle of water from the most remote part of the watershed to reach the outlet. Attempts have been made to correlate time of concentration and watershed area; however, two factors probably of greater importance are (1) length of travel, and (2) slope. Slope can be evaluated in two ways: (1) If H_1 is the difference in elevation in feet between the most remote point and the outlet, and L is the length of travel in feet, then the slope S_1 is H_1/L. (2) If H_2 is the average height of the watershed above the outlet in feet, and A is the area of the watershed in square miles, then $S_2 = H_2/A$ (in feet per square miles). A topographic map of the watershed is necessary in order to determine H_2.

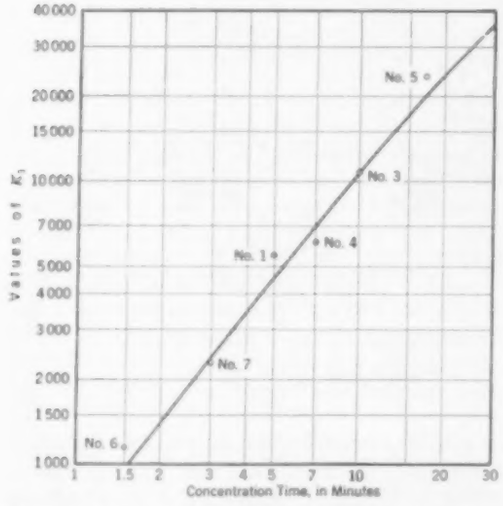

FIG. 1. CONCENTRATION TIME OF SMALL AGRICULTURAL WATERSHEDS, BASED ON K_1 AS DEFINED IN TEXT

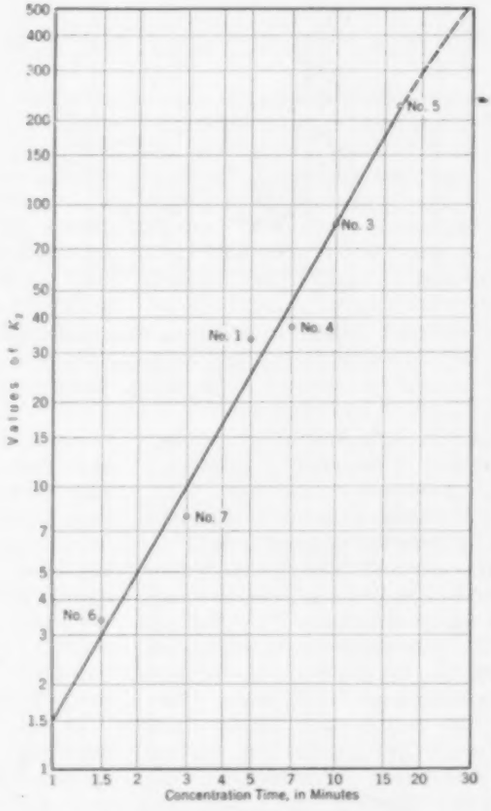

FIG. 2. CONCENTRATION TIME OF SMALL AGRICULTURAL WATERSHEDS, BASED ON K_2 AS DEFINED IN TEXT

In the two curves shown (Figs. 1 and 2) it is assumed that the time of concentration for any watershed depends on a factor, K, which varies directly with the length of travel and inversely with the square root of the slope. Thus $K_1 = L/\sqrt{S_1}$ and $K_2 = L/\sqrt{S_2}$. For a given watershed the slope should be measured in both ways and the concentration time read from each curve. An average value may then be used, although it will generally be found that the two values are rather close.

The curves are based on data obtained by C. E. Ramser, M. Am. Soc. C.E., Chief, Watershed and Hydrologic Studies, Soil Conservation Service, Department of Agriculture, in the course of experiments conducted on small agricultural areas extending in size from 1.25 acres to 112.0 acres. (See "Runoff from Small Agricultural Areas," by C. E. Ramser, *Journal of Agricultural Research*, May 1927, Vol. 34, No. 9.) These areas, all located on a farm in Tennessee, were characterized by well-defined divides and drainage channels, the topography being quite hilly, and typical of the steepest lands under cultivation in the vicinity. Owing to little or no protection against erosion, the top soil on the steeper slopes had been washed away. The proportion of each area in timber varied as indicated in Table I.

The points on the curves are numbered to correspond to the watersheds upon which the studies were made, data for which are given in the table. Data in Cols. 1 to 6 are from the publication cited; data in the remaining columns were determined by the writer from a topographic map in the same publication. Despite the apparent differences in slope and percentage of timber, the curves show that a consistent relation does appear to exist between concentration time and the factors K_1 and K_2; hence it is believed that the curves are applicable to the average small agricultural area ranging in size from 1 to 200 acres.

TABLE I. CONCENTRATION DATA FROM SEVEN SMALL WATERSHEDS

(1) Watershed No.	(2) Time of Concentration in Minutes	(3) Area in Acres	(4) Percentage in Timber	(5) Distance from Farthest Point to Gaging Station L in Ft	(6) Average Fall from Farthest Point to Gaging Station S_1 Ft per Ft	(7) Average Height of Watershed Above Outlet H_2 in Ft	(8) Average Slope of Watershed $S_2 = H_2/A$ Ft per Sq Mile	(9) $K_1 = L/\sqrt{S_1}$	(10) $K_2 = L/\sqrt{S_2}$
1	5	20.7	14.0	1,220	0.0489	43	1,330	5,520	33.5
3	10	49.2	24.7	2,152	0.0399	48	627	10,800	86
4	7	15.7	38.9	1,418	0.0544	36	1,468	6,080	37
5	17	112.0	23.9	3,933	0.0274	54	308	23,800	225
6	1½	1.25	0.0	359	0.0978	17.6	11,300	1,150	3.4
7	3	2.79	55.5	672	0.0853	32	7,340	2,300	7.9

Accurate Azimuths from Direct Solar Observations by Special Solar Shield

By C. H. WALL, Assoc. M. Am. Soc. C.E.
ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, OHIO STATE UNIVERSITY, COLUMBUS, OHIO.

THE sun provides a convenient means of obtaining direction or azimuth, not only because it affords light by which the instrumentman can observe and record his data, but because it produces a bright image which he can study close at hand. The writer has taken advantage of these circumstances in his solution of the problem of obtaining accurate azimuths.

One complication is that the sun travels rather fast and therefore offers difficulties in pointing and also in timing.

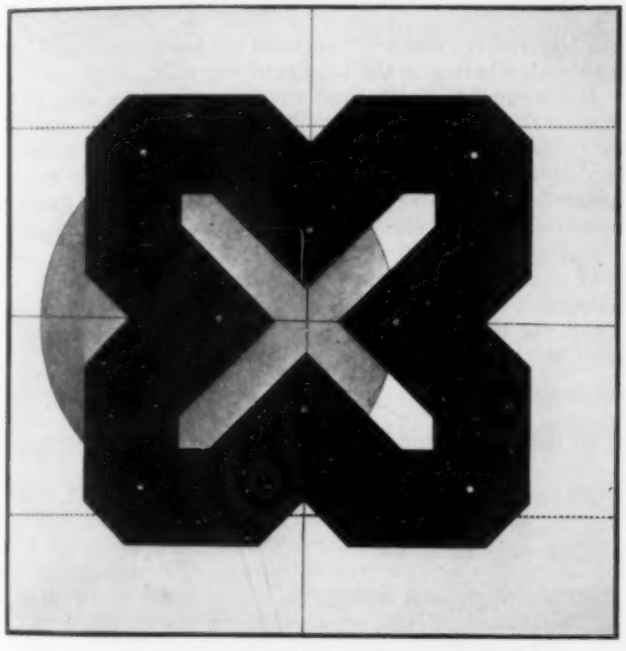

FIG. 1. SHIELD (IN BLANK) CENTERED ON CROSS HAIRS
Sun's Image Is in Second Position, as Shown by Coincidence of Its Perimeter with Three Small Openings in Shield

After considerable thought a method was found, making it possible both to secure accurate pointing on the center of the sun, and to guarantee accurate time intervals between successive pointings. As a result of a program of extensive study a small shield of symmetrical design has been devised to be placed in front of a plate on which the sun's image and the cross-wires of the transit may be focused, as shown in Fig. 1. The shape and size of this shield are such as to match the sun's image and facilitate successive timing as the image moves.

In operation the transit is set up and pointed in some arbitrary direction slightly in advance of the sun's position. As the sun comes into the field of the instrument, the shield casts a shadow on the plate; and it is this well-defined shadow with its notches, points, and holes, which enables the instrumentman to follow with the vertical tangent adjustment the sun's image as it travels across the plate, while recording the time and inclination-angle data necessary for azimuth computations.

The special advantages of this method are accurate points on the sun's center, and also accurate time intervals between pointings, which afford a check on the altitude readings, since the design of the shield easily facilitates these very important steps in field procedure. That is, the observer knows when to take the pointings, has ample time to record the necessary data, and is warned by the position of the image on the plate when to take the next pointing.

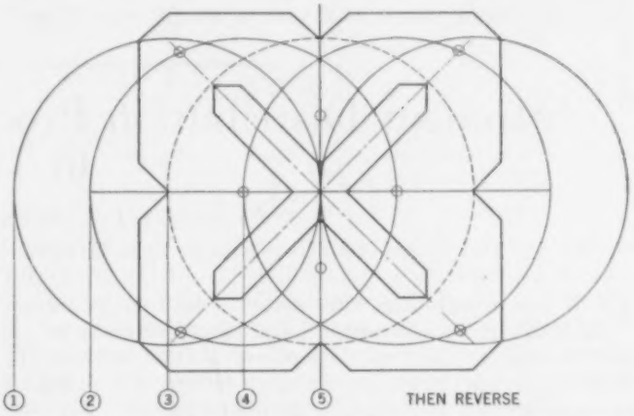

FIG. 2. SUCCESSIVE POSITIONS OF SUN'S IMAGE WITH RELATION TO SHIELD AND CROSS HAIRS
Vertical Adjustments of Telescope Are Made to Correspond

A complete observation utilizes five positions of the sun with the instrument in the direct position (Fig. 2); then five similar positions of the sun when the transit is reversed. This makes a total of ten pointings on the center of the sun, with accurate time intervals between.

TRANSIT, WITH SOLAR SHIELD ATTACHMENT

If the latitude is not available from a map, the shield is again useful in obtaining data for an accurate latitude determination, because the sun can be observed in several positions before the meridian is reached; then in several positions after the meridian is crossed. Since the data obtained at these several positions are sufficient to give not only accurate vertical angles, but also accurate vertical rates of travel, it becomes a simple matter to compute the additional vertical rise in each case to arrive at the highest point on the curve, that is, at the meridian. The mean of these determinations, when properly combined with the sun's declination, gives the latitude accurately.

The shield lends itself to almost any established method of taking solar observations by the direct method. Briefly, the field procedure consists of orientation on the base line; then a careful adjustment of the shield for observation. The horizontal circle is set ahead of the first position at a convenient reading, which is readily checked, and remains clamped during the series of five pointings.

The vertical-angle slow-motion screw is operated to center the sun's image as it arrives at the several positions, for each of which the time and the vertical angles are recorded. The vertical rate determination then affords a valuable check on the observed angles when this rate is combined with the corresponding time intervals, thereby providing field data that will insure accuracy in the final direction of the line.

This attachment, which is named the Simplex solar shield, has been patented by the writer, but is not available commercially.

Moment Distribution Procedure for Frames Subjected to Torsion

By SAMUEL T. CARPENTER, ASSOC. M. AM. SOC. C.E.
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IN a recent problem the writer found it necessary to compute the stresses in a frame subjected to an applied torque. The type of problem is illustrated in Fig. 1, in which concrete columns and girders are shown square in cross section to simplify the explanation. The sections are assumed to be properly reinforced. Let the applied torque T be equal to $F \times L_b$. The applied torque will produce bending in the girder about axis 1–1, bending in the columns about axis 2–2, and torsion in both the columns and girders. It is desired to evaluate these effects.

The method used to solve the problem is basically the moment distribution process modified to include torsion as well as moment. In the moment distribution process stiffness and carry-over factors are needed. The stiffness in bending for a member having a uniform cross section is commonly defined as I/L. For the purpose of this problem, which will combine bending with torsion,

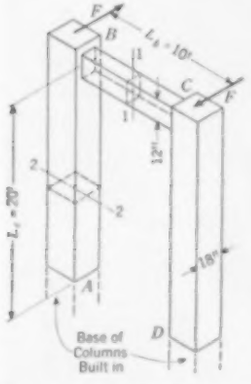

FIG. 1. FRAME SUBJECTED TO TORQUE

FIG. 2.

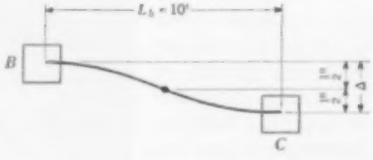

FIG. 3.

the stiffness in bending will be defined as a moment equal to $4EI\theta/L$. If θ is made equal to unity, the stiffness reduces to $4EI/L$. The carry-over factor is $^1/_2$ for a member in bending.

For a member in torsion the applied torque is equal to $KG\theta/L$, in which

K = a factor dependent upon the type or shape of cross section and upon the end conditions
G = shearing modulus
L = length of member
θ = relative twist angle in radians

Values of K may be obtained from *Formulas for Stress and Strain* by R. C. Roarke (McGraw-Hill, New York). For the square cross sections used in this discussion, $K = 0.1406a^4$, where a is the length of one side.

If θ is equal to unity the torsional stiffness of the member, or the torque necessary to produce a twist angle of unity, will be KG/L. The carry-over factor for a member in torsion is equal to -1. This may be established as true by considering Fig. 2. If T is the applied torque at A in a positive direction, then T_1 at B is equal to T but opposite in direction.

If the members are of concrete, E can be taken as 3,000,000 lb per sq in. and G as 1,400,000 lb per sq in. Then, for the problem of Fig. 1, the following stiffnesses may be computed.

Stiffnesses of Girder:

In bending about axis 1–1, $\frac{4EI}{L} = 172.8 \times 10^6$ lb-in.

In torsion, $\frac{KG}{L} = 34.0 \times 10^6$ lb-in.

Stiffnesses of Columns:

In bending about axis 2–2, $\frac{4EI}{L} = 438.0 \times 10^6$ lb-in.

In torsion, $\frac{KG}{L} = 86.0 \times 10^6$ lb-in.

The solution will be developed in two steps.

Step 1. Displacement of Girder:

Displace the joints B and C of the frame in the direction of the forces F while all joints are locked against rotation about any axis. This displacement develops fixed-end moments in the girder and column. Step 1 is concerned with the fixed-end moments in the girder only. For our purpose, displace joints B and C an arbitrary amount of $^1/_2$ in., giving C a displacement of 1 in. relative to B. This movement is indicated on a plan view of the frame in Fig. 3. The fixed-end moments developed in the member BC are equal to $6EI\Delta/L^2$, or 2.16×10^6 lb-in.

When either joint B or joint C is unlocked for the distribution of unbalanced moments, torsion will be developed in the columns. Hence, in determining the distribution factors, the stiffness of the girder in bending and the stiffness of the column in torsion must be used. The distribution ratios are:

$$\text{To girder, } \frac{172.8}{172.8 + 86} = 0.667$$

$$\text{To column, } \frac{86}{172.8 + 86} = 0.333$$

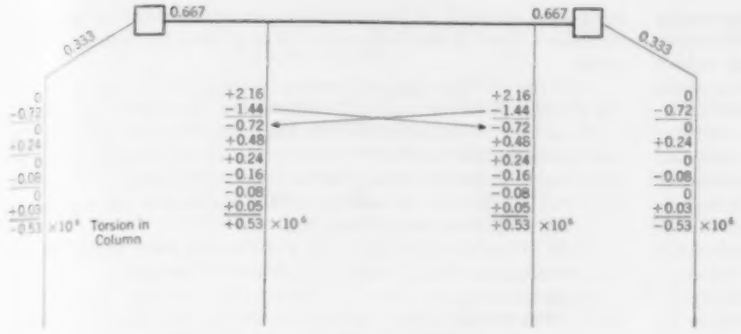

FIG. 4. DISTRIBUTION OF FIXED-END MOMENTS IN GIRDER

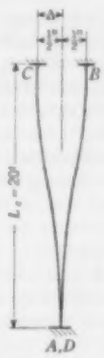

FIG. 5.

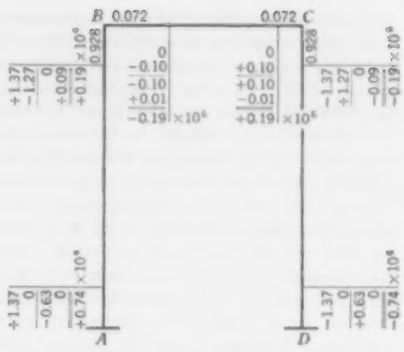

FIG. 6. DISTRIBUTION OF FIXED-END MOMENTS IN COLUMNS

The distribution, as shown in Fig. 4, gives for the shear in the girder $\frac{2 \times 0.53 \times 10^6}{10 \times 12} = 8{,}840$ lb, and for the torsion in one column, 530,000 lb-in.

Step 2. Displacement of Columns:

The arbitary deflection of points B and C ($\Delta = {}^1/_2$ in.) also generated fixed-end moments of $6EI\Delta/L^2$, or 1.37×10^6 lb-in., in the columns (see Fig. 5). For this case the girder will be in torsion and the column in bending, and the distribution ratios will be:

$$\text{To girder, } \frac{34}{34 + 438} = 0.072$$

$$\text{To column, } \frac{438}{34 + 438} = 0.928$$

This distribution (Fig. 6) gives $\frac{(0.74 + 0.19) \times 10^6}{20 \times 12} =$ 3,870 lb, for the shear in the column and 190,000 lb-in. for the torsion in the girder.

With Steps 1 and 2 completed the results may be combined, considering the equilibrium of the structure under the torsional loading. The applied torque T necessary to cause the arbitrary deflections may be ascertained by passing a horizontal plane through the columns and considering the free-body above the plane.

Torsion in two columns = $2 \times 530{,}000 = 1{,}060{,}000$ lb-in.

Resistance to torsion accounted for by shear in columns = $3{,}870 \times 12 \times 10 = 465{,}000$ lb-in.

$T = 1{,}525{,}000$ lb-in.

The force $F = 1{,}525{,}000/120 = 12{,}710$ lb. Of the total force F, only 3,870 lb go into the column as shear.

The ratio of all bending moments, shears, and torsion to the arbitrarily applied torque may be calculated and the ratios so found may be used to distribute any applied torque. The ratios for this example are as follows, where T must be substituted in pound-inch units:

$$\text{Torsion in girder} = \frac{0.19T}{1.525} = 0.125\,T$$

$$\text{Torsion in column} = \frac{0.53T}{1.525} = 0.348T$$

$$\text{Shear in girder} = \frac{0.00884T}{1.525} = 0.0058T$$

$$\text{Shear in column} = \frac{0.00387T}{1.525} = 0.0025T$$

$$\text{Bending moment in girder} = \frac{0.53T}{1.525} = 0.348T$$

$$\text{Maximum bending moment in column} = \frac{0.74T}{1.525} = 0.485T$$

The solution depends upon the validity of K. K is usually based upon the assumption that the member is free to warp at the ends. If this condition is violated then K should be modified, although, for compact sections as used in this example, the modification is probably negligible.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Use of Gelatin as a Photoelastic Material

TO THE EDITOR: To those individuals who have had or may have occasion to attempt the use of gelatin as a photoelastic material, the article by Professors Farquharson and Hennes in the April issue should prove very valuable. Engineers who never expect to work directly with photoelasticity may profit by a knowledge of some of the technical difficulties involved and be better able to judge whether information of value in the solution of their particular problems may be obtained by this method.

There is some doubt regarding the applicability of photoelastic analysis to stress problems in soil masses. Whether this method or a Boussinesq-type equation is used, the assumption is made that the stress distribution is essentially the same as though the earth mass were elastic, and the effect of the stresses is interpreted with a knowledge of the behavior of the mass under load. Most

methods of analysis should be considered as merely supplying additional evidence in a problem, final judgment being based on a study of all the evidence that can be gathered with due regard for its value. In some cases, this evidence is only qualitative due, for example, to inaccuracies in the method of analysis or the violation of similarity conditions between a model and its prototype, but it may be very valuable when no better information is available.

Since the dead load is a large stress-producing factor in soil masses, the use of a transparent material—such as gelatin—sensitive enough optically to show an interference pattern due to its own weight has been required. An alternative method, as was pointed out some years ago, is to use a less sensitive material, such as bakelite, and replace the gravitational field by a centrifugal field of force sufficiently strong to produce enough fringes for analysis. This was done by placing a centrifuge machine in the field of a polariscope and photographing the model during rotation, using a stroboscope as a light source. Recent investigations have shown the value of "freezing" stresses in bakelite by loading at annealing temperatures and slowly cooling to room temperature while under load. A logical development, which is being attempted at the present time in our laboratory, for the determination of dead load stresses is to "freeze" in a model the stresses obtained by centrifugal force, using a centrifuge in a temperature-controlled oven, and to analyze the result later in the ordinary polariscope. It should also be possible to superimpose additional loads at room temperature on a model with the gravity stresses already present and obtain the final stress system.

Two items in particular may be singled out as contributions of the authors to the technique of handling gelatin models: the calibration of the model material by using Boussinesq's equation and the pattern given by a strip loading applied to a remote edge of the large model itself, and the lubricating medium of hydrolized gelatin between the model and the glass plates.

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Assistant Professor of Civil Engineering
University of California

Berkeley, Calif.

Effect of Ground Water on Settlement of Piers

DEAR SIR: In Professor Kimball's interesting paper on "Settlement Studies of Huey P. Long Bridge" in the March issue, he calls attention to the fact that many structures change elevation with changes in level of the surrounding ground-water table, that a rise of the water table results in a rise of the structure and vice versa. However, he points out that, for the bridge piers, the action was exactly the opposite—that is, a rise in the water surface in the river causes a settlement of the piers. The paper concludes with the statement that "there has been no sound explanation offered" for this phenomenon. The writer offers the following explanation.

Ground water influences the load on the soil, and hence settlement and rebound, in two respects: (1) by submergence, the resulting buoyancy of which reduces the soil load, and (2) by frictional forces of seepage, which increase the load on the soil in the direction of seepage.

In connection with the structures mentioned by Professor Kimball, the direction of flow of ground water was probably nearly horizontal and the vertical components of seepage forces were negligible. In such cases, the only remaining influence was submergence. A rise of ground-water surface simply submerged more soil and reduced the soil load, causing the foundation to rebound, and the structures to rise. A drop in ground-water level reduced submergence, increased the soil load, and caused settlement.

However, in the case of the bridge piers, the conditions were just the opposite. There was no change in submergence of the river bed, since it was submerged at all times. Changes in submergence of the bridge piers were negligible in comparison with other forces. Therefore, the only remaining influence in this case was due to the frictional forces.

As the river rose and fell, the adjacent ground water rose and fell, but there was considerable lag. When the river was high, it was above adjacent ground water. Therefore, there was a flow out of the river—nearly vertically downward under the river, then in a horizontal direction as the pore water stream lines swung in towards the shore, then upward to replenish and raise the adjacent water table.

Thus the vertical frictional seepage forces created a vertical loading in the foundation and a corresponding settlement of the piers.

When the river reached the low stage, its surface was below adjacent ground-water level and the flow was in the opposite direction, resulting in opposite seepage forces (vertically upward in the river bottom), a reduction of loading, and a rebound of the foundation with corresponding rise of the piers.

In all probability levels on the shore would have indicated rises and settlements exactly opposite to those of the piers.

Similar conditions exist at a dam resting on a deep earth foundation. The seepage out of the bottom of the reservoir is downward, thence horizontal under the dam and finally upward to the surface below the dam. Regardless of the porosity of the foundation, the head of water against the dam is resisted by frictional seepage forces. Hence any increase in depth of water in the reservoir increases such frictional forces throughout the flow net and results in settlement of the bottom of the reservoir.

WILLIAM P. CREAGER, M. Am. Soc. C.E.
Hydraulic Engineer

Buffalo, N.Y.

More Suggestions for Days of Retirement

DEAR SIR: I read Robins Fleming's article, "Compensation for Days of Retirement," in the February issue, with a great deal of interest. Since I was forced to retire on the advice of my physician some five years in advance of the limiting age of retirement, the question of an avocation was suddenly forced upon my attention. While I had given this matter some thought, as any right-minded person should, my mind was not entirely made up by the time the subject was forced on my attention.

One of the things that I have been able to do with some degree of satisfaction to myself, and apparently in such a manner as to be of interest to my audiences, has been to give a series of lectures on rapid transit in New York, in which field I was employed for many years. These lectures have been given to engineering student groups, Rotary clubs, and other organizations.

Greater time to read not only more extensively but also more intensively is a privilege that comes with retirement, as suggested by Dr. Fleming. This applies not only to general reading but also—perhaps to a greater extent—to engineering literature. One may also derive great interest from the study of the different engineering structures that one encounters in traveling. Recently, for instance, it was my good fortune to be able to make a trip through some parts of the South, where I saw many fascinating engineering projects, ranging from a new lift bridge under construction at Jacksonville, Fla., to the great Huey P. Long cantilever bridge across the Mississippi, above New Orleans. Many of the structures I saw afforded opportunity for most intensive study had time permitted.

Another diversion that has been of interest to me, and which is more in the nature of a hobby, is the study of the great hymns used by the churches of the United States in their services. That study was followed in the fall of 1939 by a series of lectures before a certain church in my locality. I expect to give another series of lectures on this subject during the coming fall.

There are two other hobbies I am now able to pursue with greater diligence than heretofore. One of these is the development and care of the lawn and flower garden about my home. Before my retirement I was never able to do this with any great degree of satisfaction, because of the very limited time at my disposal after reaching home from a business day in New York City. The other hobby—walking and mountain climbing—has always given me a great deal of pleasure. The region in which I live is a fascinating one for hikers. All through the Bear Mountain area, in fact, there are trails that are of ever-increasing interest to nature lovers.

Thus, on the whole, it does not seem to me that time should necessarily hang heavily on the hands of those who have retired from the active pursuit of business.

CHARLES E. CONOVER, M. Am. Soc. C.E.

Pearl River, N.Y.

Effect of Vibration on Cohesionless Materials

TO THE EDITOR: In connection with the interesting article by A. K. B. Lyman, published in the April issue under the title, "Compaction of Soils by Explosives," a few comments may be pertinent.

Colonel Lyman states, "The action of vibratory forces on cohesionless materials is quite pronounced. Loose soils, either fully saturated or dry, consolidate rapidly through a reduction of the void spaces between the soil grains; very dense soils, on the other hand, tend to expand by increasing the void spaces between the soil grains."

Both the theory and practice of concrete and soil compaction by vibration speak against the latter part of this statement. A laterally confined mass of loose material can expand only if its particles move upwards, but in a "true" vibration process an upward movement of the mass is precluded since the upward impacts due to the vibration are never allowed to exceed the weight of the mass. An upward movement of the grains will occasionally occur only on the surface of the vibrated material.

The bulk of data on vibration of loose material is found in the literature on concrete construction. The eminent French engineer, M. Deniau, in his article, "Recherches sur le serrage du béton" (*Science et Industrie*, February 1934), observes that further vibration of "thoroughly condensed" concrete is useless because no movement of the grains relative to one another is possible, since thoroughly condensed concrete moves as one mass but is never loosened by further vibration.

The writer has condensed by means of vibration and simultaneous water injection (vibroflotation) sandy soil up to from 80 to 95° of compaction ("A New Soil Compacting Device," *Engineering News-Record*, July 20, 1939). In this case, too, a loosening of the soil by further vibration was not observed. Colonel Lyman does not specify what he means by "very dense" soil, but it is improbable that any uncompacted soil would be of 80° of compaction or more.

Colonel Lyman states that the success of the majority of soil compaction methods, and especially of his method, is due to vibration occurring during the process of compaction. But the compaction effect of his method seems to be different from that of true vibration. The illustration (on page 206), entitled "Typical Compaction Blast at Franklin Falls Dam Site," shows that the first effect of the blast is to send a part of the soil into the air. The ultimate compaction is due, first, to the impact of the material dropping down and, second, to internal vibration produced by the explosion. A very dense soil will be loosened by this method. The degree of compaction—58—reached by Colonel Lyman, is much higher than the original one, but only because the soil was very loose in the natural state—28° of compaction.

Although the degree of compaction attained by the explosion process is not sufficient for heavy foundation work, this method will be useful in all cases where only moderate compaction is required. It is to be hoped that Colonel Lyman will give us further information on technique of soil compaction by explosion as well as costs data to facilitate a comparison with other compaction methods.

S. STEUERMAN

New York, N.Y.

Railroad Experiences

DEAR SIR: In 1885 during the building of a railroad bridge across the Arkansas River, a caisson was carried away by a flood. It went downstream some distance and, after some concrete had been blasted out, it was brought back by the local ferry boat and two river steam boats. After this experience Denny, one of the sand-hog foremen, observed "that Pier 3 is a 'ditrimint' to the job." I only observed, "The contractors have to expect some contingencies like that." Replied Denny, "Yes, indeed, a man has to continge like hell on a job like this!"

The winter was very cold on that job, so that teams crossed on the ice. Raising the draw span to an open position, we had to cut a channel through the ice to accommodate the car ferry. One morning a man came down off the draw to get a drink, kneeling and putting his hands on the ice. But his hands slipped and he went in. Later, when I came down on the work, the general foreman told me of this with great delight and offered to show me just how it happened. Unfortunately, his hands also slipped and in he went. No sooner had his head emerged than he declared emphatically, "I don't want to hear a damned word about this."

Speaking of a certain railroad location, an attorney once said to me, "You know I studied engineering a little and know all about it. I looked up the location of this road myself and it's the finest you ever saw. Why, on the first forty miles there isn't one single foot of tangent."

C. D. PURDON, M. Am. Soc. C.E.

Paris, Tex.

The Green Mountain Dam Spillway

TO THE EDITOR: The Green Mountain Dam spillway, studies of which were described by Mr. Douma in the March issue of CIVIL ENGINEERING, presented some interesting problems.

The item relative to true values of velocity heads for variable velocity cross sections bears real significance in this case where the velocities run very high. Using computed losses, together with observed model water surfaces and velocity heads based on V_a, was an ingenious idea. However, it would probably not be well to place too much reliance on it. Flow conditions under such high velocities as in the prototype make translation of model results doubtful. Velocity distribution might be much exaggerated in the prototype.

As stated by Mr. Douma, the velocity distribution departs further from uniform with increase in velocity. The largest factors given in Table I signify about such distribution as parabolic vertical velocity curves, with the parabola concave to the axis of V, and the minimum velocity three-tenths the maximum. The least would be like trapezoidal vertical velocity curves with the minimum between one-half and two-thirds the maximum. It seems quite possible that the velocity distribution might be appreciably further from uniform than these.

D. D. CURTIS, Assoc. M. Am. Soc. C.E.
Professor of Mechanics and Hydraulics, Clemson College

Clemson, S.C.

Civil Engineering Training Should Be Flexible

DEAR SIR: I was interested in Mr. Hastings' article on "Training for Civil Engineering Students," in the "Items of Interest" department of the May issue. Many, if not most, college students develop very quickly into amateur educators, with all the amateur's impatience with the professionals and their "out-of-date methods." This interest in pedagogy they often pursue after graduation, as Mr. Hastings apparently has done, and as indeed I have myself.

Certainly this interest is to be encouraged, and for that reason I hesitate to criticize Mr. Hastings' suggested curriculum. However, I do wish to comment. Mr. Hastings has presented a course of study which no doubt is well suited to him or to anyone else with similar interests and aptitudes. On the other hand, I have in mind a quite different curriculum which I think is ideal—for me and perhaps a few others. It is my opinion that flexibility is all-important in any curriculum, that as much latitude as possible should be allowed the student in choosing his courses.

Emphasis should, I feel, be laid on the fundamentals of mathematics and science if educated engineers, not trained technicians, are the goal of the engineering schools. Beyond a few required courses, however, I believe a program of engineering study should be planned by student and faculty adviser to meet the individual's particular needs and desires. (By this same reasoning I feel strongly that the approved curriculum of the E.C.P.D., for certification to state licensing boards, is far too rigid.) Certainly any attempt to cast engineers in a mold should be avoided.

WILSON V. BINGER, Jun. Am. Soc. C.E.
Junior Engineer, U.S. Waterways Experiment Station

Vicksburg, Miss.

SOCIETY AFFAIRS

Official and Semi-Official

Denver Convention in Outline

Technical Sessions, Covering Bureau of Reclamation and Activities of Six Divisions, Vie with Social Program

SOCIAL AND technical activities of the Society as a whole are now directed toward the next major event on the calendar—the Denver Convention, set for July 24–26. Preparations are virtually complete, indicating that a fine program of technical sessions, social events, and scenic trips is in store for many Society members and guests in July.

Headquarters are to be at the Brown Palace Hotel and there most of the events will center, beginning on Wednesday morning, July 24, when the Convention will be officially called to order. After the usual opening formalities, the main event on the calendar will be the President's Annual Address. Delivery of this at the Convention is a constitutional requirement. The afternoon likewise will be given over to a topic of general interest. It is especially fitting that the Bureau of Reclamation, whose engineering activities center in Denver, should receive attention at this time, and the entire afternoon will be devoted to various features of its widespread interests.

Technical sessions will be held on three half days—Thursday morning, Friday morning, and Friday afternoon. In all, 11 separate sessions are scheduled, sponsored by six of the Society's Technical Divisions. These Division meetings have been assigned the following times and general subjects:

THURSDAY, JULY 25—MORNING

Hydraulics Division

- Conformity Between Model and Prototype of Spillway Flow over Madden Dam
- The Use of Models in Designing Outlets at Dams

Soil Mechanics and Foundations Division

- Report of the Subcommittee on Cores, Cutoffs, and Impermeation
- Types of Earth Dams
- Report of Committee on Sampling and Testing

Surveying and Mapping Division

- Methods and Problems of the U.S. Cadastral Engineering Service
- The Denver Topographic Survey

Structural Division

- New Solution of Stresses in Circular Plates
- Earthquakes and Structures

FRIDAY, JULY 26—MORNING

Irrigation Division

- Multiple Use Aspects of Irrigation Projects
- Activities of the Mexican National Commission of Irrigation

Soil Mechanics and Foundations Division

- New Theories and Concepts in Analytic Soil Mechanics
- New Theories and Concepts in Analytic Mechanics, as Applied to Earth Dams
- Other Methods of Analytic Soil Mechanics

Highway Division

- Rational Method of Analyzing Highway Fills
- The Monarch Pass Highway Project

FRIDAY, JULY 26—AFTERNOON

Irrigation Division

- Classification of Water for Agricultural Use
- Consumptive Use of Water for Agriculture

Soil Mechanics and Foundations Division

- A Study of Stability Analyses Methods—Report of Subcommittee on Structural Design of Embankments and Foundations
- Report of Subcommittee on Consolidation of Embankment and Foundation Materials
- Compaction of Cohesionless Foundation Soils by Means of Explosives

Highway Division

- Colorado State-wide Planning Survey
- Developments in Bridge Engineering in the West

Hydraulics Division

- Silt Problems of the Imperial Dam and the All-American Canal
- Hydraulic Phenomena in Large Penstock with Particular Reference to Plant at Boulder Dam

Few members will fail to find in these meetings several competing topics of interest. It is evident that the program committee has arranged a most worth-while distribution of subjects that will attract wide attention.

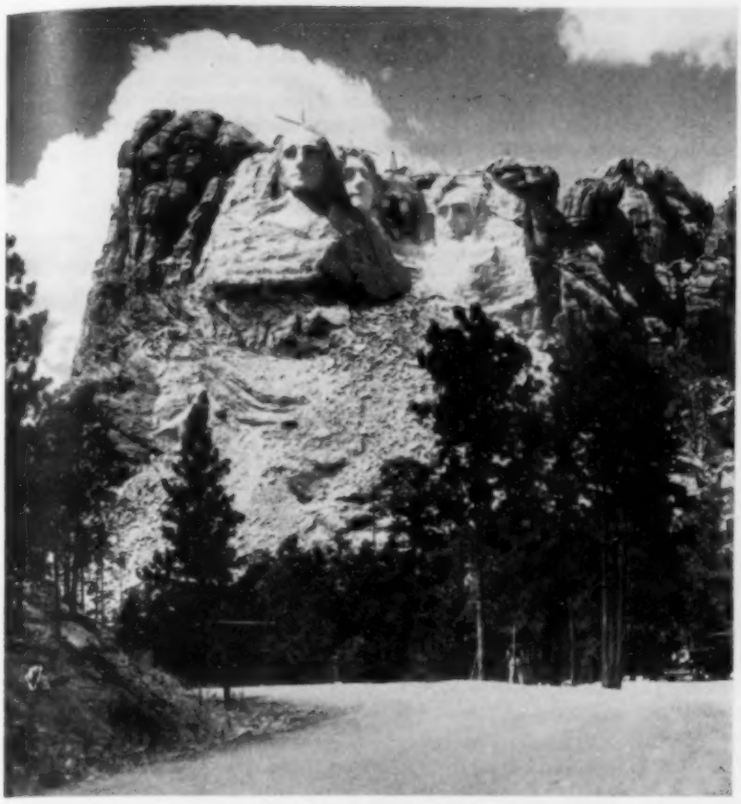
A number of pleasurable events have been arranged for the ladies throughout the program, including teas, inspection trips, and drives. For the joint entertainment of members and their ladies,

DENVER CIVIC CENTER

interest will focus as usual on the dinner dance, for which Wednesday evening has been reserved. It is expected that this will be held at a picturesque country club nearby.

On the following afternoon (Thursday), both men and women are invited to the open house at the Bureau of Reclamation. It will thus be possible to get a closeup of the intensive and widespread activities of this large engineering office. Both the Bureau and the visitors are looking forward to this visit with keen anticipation.

As the final event of the day, plans have been perfected for the entire group to visit Central City, a historic spot back in the mountains west of Denver. After a dinner in this interesting town, there will be a performance of grand opera at the celebrated Central City Theater, in which stars of the Metropolitan Opera Company will participate in presenting "The Bartered Bride" by Smetana. After the performance buses will convey the party back to Denver.



MT. RUSHMORE MEMORIAL

Even before the Convention begins on Wednesday, a number of events are scheduled. Starting as early as Sunday, the Board and its committees will begin their sessions. Provisions have been made for a Local Sections Conference as well as a Junior Forum on Tuesday.

Following the meeting, opportunity will be offered to see the wonderful mountain and engineering features around Denver. Both a two-day trip, to include the Rocky Mountain National Park area and the Grand Lake project, and a one-day trip to the summit of Mount Evans, are possibilities that the local committee has had in mind. Another possibility is Colorado Springs and Pike's Peak. The San Francisco Golden Gate International Exposition will doubtless attract many from the East. Similarly the World's Fair in New York will attract those from the West. The entire transcontinental trip can be arranged to fit in with the Denver Meeting.

TOUR TO PRECEDE CONVENTION

Patterned after the successful tours of previous years, a special trip for those attending from the East has been planned to precede the Denver Convention. This official tour will start from Chicago on Wednesday, July 17, but travelers may join at any other convenient point. The objective is a two-day automobile trip through the Black Hills in South Dakota, a mountain area six or seven thousand feet in elevation that is becoming increasingly popular.

While the party goes by train to New Castle, Wyo., and returns there after the tour, most of the time will be spent in the western part of South Dakota, in that picturesque region once the hunting grounds of the war-like Sioux Indians. Outstanding among the scenic features are the monumental memorials at Mt. Rushmore, with completed busts of Washington, Lincoln, and Jefferson carved out of solid granite. The party will have special courtesies and be privileged to see the work going on to complete the last figure, that of Theodore Roosevelt. The tour will also reach the top of Mt. Coolidge and will traverse the Needles Highway and Harney Canyon, including among other spots the top of Mt. Roosevelt, the Stratosphere Bowl, and the Homestake Gold Mine. After boarding the train on Saturday afternoon, the party will reach Denver early Sunday morning, July 21, in time for various advance meetings of Society and Board committees or, if desired, for three days of sightseeing in the Rockies before the Convention.

To those interested in this trip, a folder will be sent upon request from headquarters; or inquiry may be made direct to Leon V. Arnold, authorized director of the tour, at 36 Washington Square West, New York, N.Y. Complete details of the entire meeting and related events will be presented in the July issue. These will indicate more fully than can be done in this brief summary the unusual opportunities available to all who can attend the 1940 Denver Convention.

Meeting of Board of Direction—Secretary's Abstract, April 15, 1940

THE BOARD met at the Continental Hotel, Kansas City, Mo., on Monday, April 15, with President John P. Hogan in the chair, and Secretary Seabury and the following members of the Board in attendance: Past-President Riggs; Vice-Presidents Ferebee, Davis, Jacobs, and Lucas; and Directors Agg, Anderson, Ayres, Blair, Bres, Brooks, DeBerard, Dunnells, Goodrich, Harrington, Hudson, Hyde, Leeds, Lewis, Parker, Polk, Root, Sawin, and White. Regrets were received from Past-President Sawyer, the only absentee, who had not sufficiently recovered from a recent illness to permit him to attend.

Approval of Minutes

Minutes of the meeting of the outgoing Board of Direction held on January 15 and 16, and of the meeting of the incoming Board held on January 18, also those of the Executive Committee meeting on January 18, were approved as written.

Local Section Constitutions

Request for change in the constitution of the Lehigh Valley Section was received and the revision approved. Also the official constitution of the new Tri-City Section was received and approved.

Cooperation with Engineering Index

An invitation was presented from Engineering Index, Inc., that the Society appoint a "trustee member" to the board of the Index, to show the good will and interest of the Society, without other obligation. After discussion, the Board approved designation by the President of a member of the Society to assist the Index as desired, but not as the official representative of the Society.

Representation on National Conference on Engineering Positions

Official sanction was given to the proposed "National Conference on Engineering Positions," the objective of which is:

"To formulate a program that will embody classifications of engineering positions and compensation for services therein which can be supported by the professional engineering societies, and which will serve alike the interests of the public and the members of the profession."

The President was authorized to appoint four official representatives, one to be a Junior, to join with similar representatives from eight other national associations of engineers invited to participate.

Election of Officers

In accordance with Constitutional requirements, the offices of Secretary, Treasurer, and Assistant Treasurer of the Society were presented for appointment. The present incumbents were reappointed as follows:

Secretary, George T. Seabury
Treasurer, Otis E. Hovey
Assistant Treasurer, Ralph R. Rumery

Members in Arrears

Rules were approved with reference to all cases of members in arrears of dues, providing that pending delinquencies be satisfactorily arranged for prior to September 1, 1940.

Request for Assistance in Analyzing Sewage Treatment Costs

The Board approved of a request to be made by the Sanitary Engineering Division's Committee on Sewage Treatment Costs, to the Public Works Administration, that that agency assign personnel to analyze the construction costs of sewage treatment plants which have been built within the past five years under its supervision.

Engineering Consultation on Government Building

The Board expressed approval of that part of Congressional Bill, HR 7635, providing for retaining engineers and architects in independent practice as consultants for the federal government in the preparation of plans for buildings and other structures.

Set-up of Various Funds in Society Accounts

A change in the Society's accounting procedure with relation to the Alfred Noble Prize Fund was approved, whereby the fund was set up as independent of all other accounts.

A "J. Waldo Smith Memorial Fund," amounting to $2,797, was accepted by the Board for the Society, interest and principal of which are to be used to keep in repair a tablet and plaque at the Ashokan Reservoir in the Catskill Mountains, New York State, as a memorial to the late J. Waldo Smith, Hon. M. Am. Soc. C.E.

Financial Assistance to Research

Approval was given for official request to the Engineering Foundation for financial grants to assist the Committee on Hydraulic Research in the Hydraulics Division, and various committees of the Soil Mechanics and Foundations Division.

Discussions in "Civil Engineering"

Request having been received that the pages of CIVIL ENGINEERING be opened for discussion of any pending Constitutional amendment, the Board decided it to be inadvisable to do so or to permit comments in CIVIL ENGINEERING concerning candidates for election as officers of the Society.

Proposed Amendments

By action of a previous Board, proposed amendments to the Constitution are to be reviewed by legal counsel as to their legality, practicability, and consistency with the remainder of the Constitution, and to be commented upon by the Executive Committee when they are sent by letter to the Corporate Members.

Two amendments being in hand, the Board prepared comments which, it ordered, are to accompany the announcement of the two proposed amendments to be made in accordance with customary procedure.

Professional Conduct

Six cases of alleged violation of professional ethics were presented by the Committee on Professional Conduct, and received considered action in each instance.

Local Section Boundaries

With the approval of the Local Sections concerned, 13 counties of North Carolina, previously assigned to that Section, were transferred to the Tennessee Valley Section.

Society Meetings for 1941

On recommendation of one of the Board's committees, which had canvassed all the suggestions received on Society meeting places for the year 1941, invitations from the following Local Sections were accepted:

Spring Meeting—Baltimore, Md.
Summer Meeting—San Diego, Calif.
Fall Meeting—Chicago, Ill.

Arizona Studies

The Board approved of the action of President Hogan in sending Mr. Richmond, Assistant to the Secretary, to Arizona, in response to a request from the Arizona Local Section to make a study of the salaries paid in the Arizona State Highway Department. Copy of his recommendations to the Department were ordered incorporated in the Minutes and the Board by vote commended him and former Director Raymond A. Hill, who assisted materially. (See item in the May issue for details of survey and recommendations.)

Committee Reports

As a matter of routine, a number of Board and special committee reports were received, discussed, and appropriate actions taken.

Miscellaneous

Various routine matters concerning budget and finance, representation for special events, and similar matters, were considered, with appropriate action in each case.

Adjournment

The Board adjourned to meet at Denver, Colo., on July 21, 1940.

Meeting of the Executive Committee of the Society—Secretary's Abstract, April 14, 1940

The actions taken by the Executive Committee and its recommendations made to the Board of Direction, becoming the actions of the Board, are incorporated in the above abstract.

The Graduate Engineer's Immediate Future

Abstract of Address Before Mid-Continent Student Chapter Conference, Kansas City, Mo., April 24, 1940

By ENOCH R. NEEDLES, M. AM. SOC. C.E.
ASH-HOWARD-NEEDLES AND TAMMEN, CONSULTING ENGINEERS, NEW YORK, N.Y.

CERTAINLY the big question in our minds as we are about to graduate from college is, "What is going to happen next?" When "defeatists" tell you that "all frontiers have vanished," what do they mean? Surely they don't mean the opportunities for getting something for nothing are gone. Surely they don't refer to a life of ease with little effort. No frontier was ever worthy of the name if it could be associated with the idea of getting something for nothing. Our frontiers are our opportunities, and our own hard work will create them for us. They may not be the frontiers our fathers knew, but they will be just as much a frontier for you.

There is a tendency among young men either to create for themselves or to get from others, certain preconceptions about what life is and how they should conduct themselves in it, and these become so fixed in their minds as to become law. One of these preconceptions which appeared most tenacious while we were in college was that we should have no use for the fellow who is a glib speaker. We had been encouraged to believe that men would become so well educated and well informed that it would not be necessary for them to speak well in order to get along with their fellow men. The picture we had of the ideal man was the strong, silent, educated type—the engineer who could show what he was by his works, rather than by his words.

People have been communicating with one another through the spoken word for a long time. One of the chief ways to make a good impression on someone is to present our ideas to him effectively through the spoken word. There is a very great value to the engineer in being able to speak with clarity and to hold the attention of his listener.

Some engineering students are inclined to be very reticent, very backward, and unwilling to show real interest and enthusiasm for what they are doing—they are inclined to believe it is unworthy to "polish the apple." Don't we expect a merchant to display his goods to the best advantage? Haven't we a sort of false pride when we speak derogatively of "polishing the apple?" Why not put our best foot forward? Let's show the greatest consideration and courtesy to others, but let's give that old apple the best polish we know how, and possibly somebody may want to buy it from us, remembering that the apple must be worth polishing.

Unquestionably the problem uppermost in your mind today is having to look for a job. All of us have had the thought as graduation time came near that if we could just find that first job, life would be simple from then on. I have been looking for jobs all my life, and I'm still looking for jobs. About all my firm does is to get a new job, finish it, and look for another one. If we don't get new jobs, our firm goes out of business. While I can sympathize with your problem of how to get your first job, don't let it bother you too much. It is a continuous part of life itself.

Available Opportunities

As you look for your job, you will be thinking of three different classes of employment that may be available to you—with a corporation, with a public agency, or with a smaller private engineering concern. As you think about these three different fields, you might bear in mind that the small private firm may be on its way out. There appears to be less and less opportunity for engineers in private practice. Very likely the work for most of you will be for the most part either with a big corporation or with some public agency. Whatever you do, I am sure there is plenty of opportunity there for you if you will endeavor to make that opportunity for yourself.

As you analyze yourself you may be asking yourself such questions as, "Am I qualified by nature and equipped mentally to answer the high calling of teaching?" "Am I equipped to undertake pure research and design?" "Would I fit into the construction business as a builder and handler of men, materials, and equipment?" "Am I best suited for industry, and, if so, am I interested in the production and distribution of products or in their sale?" You may be asking other questions. "Do I prefer to get located near home where my friends may be, or am I ready to do pioneering, go to a new city, make new friends?"

What an Employer Expects

The prospective employer is going to be eager to know something about you. He'll want to know first of all if you're honest. He'll not expect you to be slick or too clever. He'll want to know what kind of a student you have been and what kind of health you have. He'll wonder if you have some self-assurance, self-respect, and if you are respectful of others. He'll try to find out how well equipped you are mentally; whether you have ambition, initiative, and energy; whether you are agreeable, friendly, and able to get along and cooperate with your fellows. He'll wonder how well you will apply yourself to your job, how much you will profit from experience, and how fast you will learn as a practicing engineer. These qualities are not unattainable. They are simply the usual qualities you desire to find in your merchant, your doctor, your lawyer, or any one in whom you wish to place confidence.

If, in addition to these things, you show a particular aptitude for your work, if you have some imagination and originality, if you show a little leadership, common sense, and good judgment, you will not have to worry about progress. You will find yourself receiving increased responsibilities. All the employers I know, even in times of depression, are constantly looking for a man who can take responsibility.

Commencement Only a Milestone

An engineering graduate may get the idea that he has passed a milestone—probably the most important hurdle that we have to take—and that everything is going to be relatively simple for us by reason of the advantage the college graduate has over the non-graduate. President Karl Compton of Massachusetts Institute of Technology has stated that the college graduate has something like seven times the chance of reasonable success over the non-college man, and that the graduate engineer has an even greater chance of reasonable success than the graduate from other courses.

While those words may be very satisfying in many ways, they are also ominous. In the last twenty years, 1920–1940, according to the personnel department of the American Telephone and Telegraph Company, the number of college graduates has tripled. In 1920 you may have been a man apart if you had graduated from college. Today your competition has been tripled. You are going to have more severe competition. This competition emphasizes the vital importance of continuing your studies, reading, and advanced work after you get through college. It would be very fine if you could get two more years of college work, but if that isn't possible, you should make a steady job of selected reading for yourself and get with other young men who are interested in advanced study. If you virtually stop your education at the time you leave college, you can't expect to get as far along as the man who is using his college work as a stepping-stone for future education and professional advancement.

As a part of your professional growth it is important to maintain your membership in the Society. During the last year our Socjety made a survey of the status of its membership, and the facts developed were startling. It revealed that 85% of our membership are college graduates; that the percentage of unemployment is very low, not over 4% for the year 1938; that the years in which a member's earnings attain the peak are those from 20 to 45 years after graduation, or from 40 to 65 years of age; that the average compensation of all the members of our Society, from the lowliest Junior to the man who is virtually in retirement, was almost $4,000 for the year 1938.

What do these figures mean about our Society? Simply that Society membership indicates a very high quality of individual, an advanced earning power, and a reasonably satisfactory social position. Membership in the Society cannot assure you success, but if you attain the standard for membership and maintain it, your chances for reasonable success would appear to be very greatly improved.

If you cannot now make up your mind whether you were cut out for designing, construction, or possibly the production and sale of engineering materials, look forward to the next three or four years as years in which you can find out what you are best equipped for, and what work you will get the most satisfaction from. In examining yourself and in studying the different types of jobs that may be available, you will find one eventually to which you can apply yourself. When you do find one you like, one you can work at with enthusiasm, then dig in and give that job all you've got.

If you will just bear in mind that our profession is chiefly one of service to our fellow men and that those who serve best will profit most, you will not have to worry about reasonable success.

At the end of Mr. Needles' address, printed above, there was a lively discussion followed by questions from the floor, which were answered by the author. The questions, given below in brief, with the answers, were offered by student members of the Chapters from the schools designated.

Question by J. M. Clark (University of Kansas): An employment scout who was interviewing some of our seniors stated that not only did they not know what they wanted to do, but they did not know what they could do. How can we better determine our ability?

Answer by Mr. Needles: I would prescribe using the next two or three years to find where your chief interests lie, for a more intimate study of the engineering profession, and for self-examination. If you are working over a drafting board at designing and would prefer to be out watching construction operations, I suggest making the change. It is only by trying different experiences that you will be able to determine what you are most interested in and most happy in doing.

Question by T. F. Buirgy (University of Colorado): We have been in school learning for four years, without outside contacts with firms that may want our services. How best can we make the right contacts?

Answer by Mr. Needles: A letter of application is a pretty unsatisfactory way to try to get a job. If I were out looking for a job this June and had no contacts close at hand, I would go where the work is and see every employer who could possibly be in the market. I would go back frequently. From practical experience I know that the reason one man gets a job and another one doesn't is dependent very often on which man happens to turn up at the right time. Of course it depends on the kind of impression he makes. There is no equivalent substitute for a personal application for a job.

Question by M. Albertson (Iowa State College): You mentioned the ratio of 7 to 1 as the chances of a college graduate's getting a job over those of a non-graduate. What would the ratio be if the man had one or two years of graduate work?

Answer by Mr. Needles: Today more than ever before, graduate work will pay very handsome dividends. It is almost essential. The first four years should be made more general than they have been in the past. We should deal more with the fundamentals. We should not try to do too much in four years, as I believe we have been doing. If things were arranged that way, another

year or two would become almost mandatory. If a man can possibly negotiate it, either through a loan or some other means of assistance, he will find it very worth while to have a couple of years of graduate work.

Question by John C. New (University of Missouri): You stated that in getting a job a personal interview is best. What do you, as an employer, expect of these young engineers when they come in?

Answer by Mr. Needles: I believe that our firm, and every other firm that I have ever heard of, is continually on the lookout for the man who can make them some money. If we like a young man's looks and he measures up in other ways, and, on top of that, shows in one way or another that he has something on the ball that the average fellow doesn't have, we immediately begin to think, "Here's a man who can do us some good." We wouldn't get that reaction from a letter. If we can discover a young man who looks as if he can make some money for us, we're always interested in him.

On the other hand, we can't all be whizzes, so to speak. You can't all make the kind of impression that I was talking about. Nevertheless, the civil engineering offices the whole country over are not filled with whizzes. There are a lot of good jobs for good, average men.

Question by C. L. Pratt (University of Missouri): Mr. Needles, is it wise in taking advanced work to take that in another school, a school of business for example?

Answer by Mr. Needles: An engineering education is the finest practical education you can have for the preparation of a business or industrial career. If a man wants to go into business and industry rather than into purely technical engineering, nothing would be better than to take two years of postgraduate work in a school of business administration.

Question by W. G. Purdy (University of Missouri): What is your opinion on the value of purely cultural subjects in the education of the engineer?

Answer by Mr. Needles: I have talked at great length in favor of more cultural subjects interspersed with our engineering subjects. I have tried to express the view that our four years of courses have been confined too strictly to purely technical subjects. An engineer should have a broad education on which to build in later life.

Question by A. M. Fishback (South Dakota State College): I would like to ask Mr. Needles what he is going to cut out of the four-year course in order to put in these cultural subjects?

Answer by Mr. Needles: The average college student is unable to use to advantage a number of the more theoretical subjects which are included in the last two years of a four-year course. Those subjects would fit much better into a graduate course.

Question by Mr. Purdy (University of Missouri): Which would be more advantageous, two years of liberal arts and four years of engineering, or four years of engineering and two years of graduate work?

Answer by Mr. Needles: I am in accord with the recent report of a special committee of the Society for the Promotion of Engineering Education which recommends a four-year engineering course having in it a large cultural content, and urges that the advanced work come as graduate study. I think that is the much more preferable way.

Question by T. G. Pfiffner (Washington University): In seeking employment what are the relative merits of the small private practice and the large corporation?

Answer by Mr. Needles: Being in the private practice of engineering, so to speak, I am partial. If a man has the chance to get with a good firm in private practice he will have a greater variety of work and an opportunity for more intensive development in an equal period of time than is possible with a corporation.

Regional Conference of Local Sections

Kansas City Host to Sixteen Mid-Western Section Representatives

PRELIMINARY TO the Spring Meeting of the Society in Kansas City, Mo., an all-day conference of representatives from the Local Sections in the central part of the United States met at the Hotel Continental on April 16 to discuss in detail the duties and functions of the Society which may properly be turned over to the Local Sections, and to determine means by which Local Sections can be made of greatest use to the profession. The Sections represented were the Central Illinois, Duluth, Illinois, Iowa, Kansas City, Kansas State, Louisiana, Mid-Missouri, Mid-South, Nebraska, Northwestern, Oklahoma, St. Louis, Texas, Tri-City, and Wisconsin. Each representative presented a special phase of the general subject, and each phase was discussed at length informally. Although the conference was arranged for the delegates, its deliberations were open to any member of the Society who wished to be present. Presiding over the sessions was James W. Follin, chairman of the Society's Committee on Local Sections, under the stimulus of which the conferences have been held for the past several years. The group picture reproduced herewith shows the official representatives and others in attendance at the time the conference was addressed by John P. Hogan, President of the Society.

After a warm welcome to Kansas City by R. N. Bergendoff, president of the Kansas City Section, the conference plunged into a discussion of the work being done by local committees on professional objectives.

LOCAL COMMITTEES ON PROFESSIONAL OBJECTIVES

In 1938 the Board of Direction appointed a Society Committee on Professional Objectives, purely advisory to the Board, charged with the duty of developing methods by which the professional, social, and economic status of the members may be advanced and to serve as a medium through which the plans that have been developed may be executed. One of the initial steps taken by the Society Committee was to obtain the cooperation of each Local Section through the appointment of a local committee on professional objectives to study the problems close at hand. To date 50 local committees are functioning, with an aggregate membership of 250.

Dr. Lorenz G. Straub, past-president of the Northwestern Section, recalled that ten engineering societies in Minnesota have joined together in the Minnesota Federation of Architectural and Engineering Societies. Although the Minnesota Section of the Society has an active committee on professional objectives, it is felt that efforts concerning engineering welfare and the public welfare can be most effectively handled through the Federation as a cooperative effort of the whole engineering profession—and the cooperation has been both wholehearted and effective.

To promote the welfare of its members in a material way the Louisiana Section organized an employment bureau in 1939 both for members and for members of its Student Chapters. According to V. J. Bedell, secretary of the Section, the bureau has enjoyed a successful year of operation. An abstract of his presentation appears elsewhere in this issue.

Theodore L. Condron, vice-president of the Illinois Section, described a systematic study recently made by that Section to index the names and experience of Illinois civil engineers qualified for membership and said that the members of the executive committee of the Section are personally approaching a selected group of these men to induce them to apply for membership.

"The Duluth Section," said W. H. Woodbury, past-president of the Section, "has three great ideals—sociability, technical advancement, and civic participation."

MAKING THE SALARY SCHEDULE EFFECTIVE

The Society has been continuously interested in the salaries which appropriately should be paid to civil engineers as compensation for their work. In January 1940 a partial salary schedule, including the lower three professional grades, was approved by the Board of Direction. The Society's Committee on Salaries is expanding its work to extend the present schedule to include additional grades and classifications.

In a thoughtful analysis of the methods by which the Society's salary schedule may be made effective in Nebraska, Roy M. Green, president of the Nebraska Section, said, "If the Society's salary schedule is to become effective locally there must be one fundamental condition met—there must be an agreement between the parties rendering the services and those paying for the services, that the services and compensations are equal in value and that neither party has taken an undue advantage of the other." He then proceeded to outline a long-time plan of educating engineers themselves to the value of their own services and of educating the public to the same appreciation. An abstract of Mr. Green's presentation appears elsewhere in this section.

In analyzing the situation in the vicinity of Kansas City, W. G. Fowler, secretary-treasurer of the Kansas City Section, pointed out the need for civil service and for rigid enforcement of a merit system for engineers employed in public service. Drawing attention to the relationship between consulting engineers' fees and the salaries paid by consultants to their employees, Mr. Fowler said that only concerted action on the part of consultants to enforce the Society's fee schedule among themselves will make it possible for them to pay salaries comparable to the Society's salary schedule. An abstract of Mr. Fowler's paper appears elsewhere in this section.

At the request of the conference, Allen P. Richmond, Assistant to the Secretary of the Society, explained in detail an objective study of classification and appropriate salaries for the Highway Department engineers in Arizona, which he had completed in April on behalf of the Society, at the special request of the Arizona Section and the Arizona State Highway Commission. A detailed account of this disinterested cooperative effort on the part of the Society appeared on page 313 of the May issue of CIVIL ENGINEERING.

JUNIOR PARTICIPATION IN SECTION ACTIVITIES

With the growing interest of young civil engineers in the Society, as evidenced by the rapid increase in Junior membership from but 800 in 1925 to over 4,000 in 1940, more and more opportunities for participation in the work of the Society are being offered to Juniors. Forums for Juniors have been established by 12 Local Sections as one means of promoting their progressive professional development; Juniors have been appointed on Section and Society committees and on local boards of directors. They have been appointed as Junior contact members of Student Chapters.

In a thoughtful paper, Prof. L. O. Stewart, secretary of the Iowa Section, emphasized that the "feeling of need" for a Junior Forum must be developed, to bridge the gap between graduation and professional registration. An abstract of his paper appears separately in this issue

In the Tri-City Section, the baby in the family of Local Sections, nearly two-thirds of the membership are Juniors, a majority of them in their late twenties or early thirties. Mr. F. L. Flynt, representing the Section, gave as the motto of the Section, "Make the Juniors do all the work."

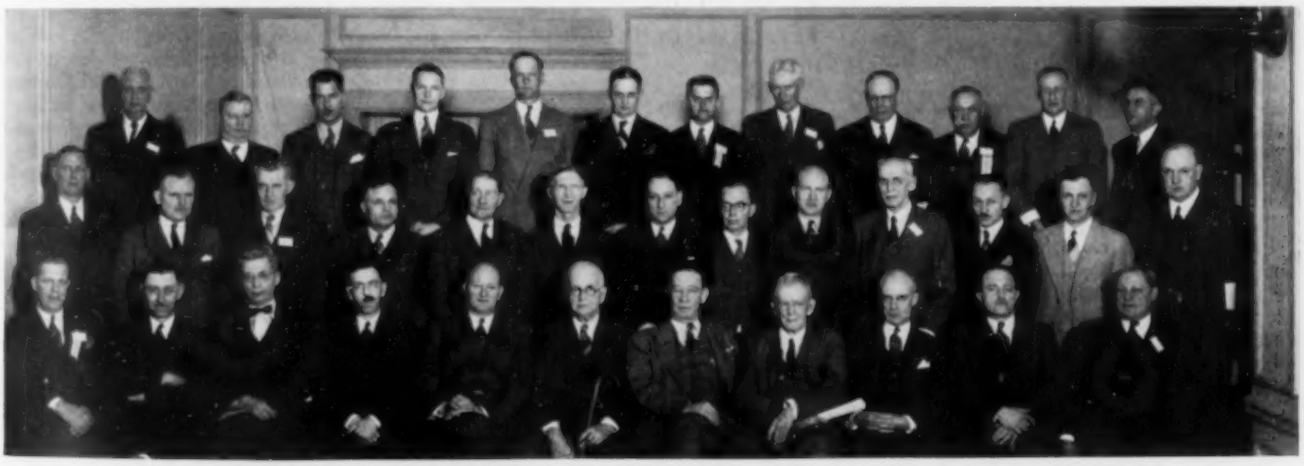
Secretary D. L. Wilson, of the Oklahoma Section, explained that his Section has two Student Chapters within its jurisdiction and that it awards annually a prize to the outstanding graduating civil engineering student in each Chapter. The prize consists of the first year's dues as a Junior in the Society. Each Chapter annually acts as host to the Section at a joint meeting on the campus. Both Juniors and students join with the Section on its inspection trips to major engineering projects. These joint affairs afford an excellent opportunity for getting better acquainted. "The Juniors can be of special assistance to Student Chapters, because of a similarity of age and viewpoint and a common educational background. With their new-found experiences in practice, they can help the students individually on job opportunities and advise the Chapters on operations, and on the service they offer," said Mr. Wilson. A spirited general discussion of Junior Forums and Junior participation in Section affairs ensued.

"At each meeting of the Mid-Missouri Section, one of our Juniors gives a résumé of some article appearing in the latest issue of CIVIL ENGINEERING or paper published in PROCEEDINGS," said R. W. Brooks, secretary of the Mid-Missouri Section. "Our Juniors show a surprising ability to present the meat out of these papers. It is my opinion that the affairs of the Society will be perfectly safe in the hands of our Juniors as they become corporate members."

LOCAL SECTION ADMINISTRATION

At the request of the Committee on Local Section, the Society Headquarters staff had prepared a tabulation showing the distribution of the 1939 cost of Local Section operations and the scope of their activities as reported in their annual reports. This tabulation was distributed and discussed by the conference. Some of the high lights revealed follow. Section officers interested in further details may obtain them by writing to headquarters.

The net income of the Sections in 1939 was derived from local dues in round figures aggregating nearly $12,000 paid by 6,500 subscribing members, and from Society assignments aggregating $19,300— a net total of approximately $31,300. Each Section also reported the number of its meetings and the number of members and guests attending them. The unit cost per member attendance for the year—obtained for each Section by dividing the total net cost of all its operations for the year by the number of members who attended the Section's meetings—varied from 30 cents to $3.00, and averaged for all the Sections about $1.25. On the average, each member of the Society belonging to a Section attended 1¾



LOCAL SECTION OFFICERS AND OTHERS IN ATTENDANCE AT CONFERENCE IN KANSAS CITY IN APRIL

Top row, left to right: C. G. Dunnells, Director Am. Soc. C.E., Pittsburgh; James A. Anderson, Director Am. Soc. C.E., Virginia; C. E. Spellman, Secretary, Nebraska Section; H. F. Thomson, President, St. Louis Section; G. W. Lamb, Secretary, Kansas State Section; R. P. Hoelscher, Past-President, Central Illinois Section; W. G. Fowler, Secretary, Kansas City Section; W. H. Woodbury, Past-President, Duluth Section; E. B. Black, Past-President, Kansas City Section; O. A. Zimmerman, Past-President, Kansas City Section; William Spann, Vice-President, Kansas City Section, Member Committee on Local Sections; John A. Focht, Secretary, Texas Section.

Middle row, left to right: R. P. Davis, Vice-President, Am. Soc. C.E., West Virginia; Walter E. Jessup, Field Secretary Am. Soc. C.E.; F. W. Epps, President, Kansas State Section; M. W. Furr, Past-President, Kansas State Section; F. L. Flynt, Tri-City Section; H. C. Beckman, President, Mid-Missouri Section; E. S. Bres, Director Am. Soc. C.E., New Orleans; V. J. Bedell, Secretary, Louisiana Section; Lorenz G. Straub, Past-President, Northwestern Section; T. L. Condron, Vice-President, Illinois Section; D. L. Wilson, President, Oklahoma Section; L. D. Knapp, Secretary, Wisconsin Section; C. M. Blair, Director Am. Soc. C.E., Connecticut.

Bottom row, left to right: R. N. Bergendoff, President, Kansas City Section; Roy Green, President, Nebraska Section; William W. Zass, President, Mid-South Section; Raymond W. Brooks, Secretary, Mid-Missouri Section; James W. Follin, Chairman, Committee on Local Sections; Henry E. Riggs, Past-President Am. Soc. C.E., Michigan; John P. Hogan, President Am. Soc. C.E., New York; Daniel W. Mead, Past-President Am. Soc. C.E., Wisconsin; Charles T. Leeds, Director Am. Soc. C.E., Los Angeles, Member Committee on Local Sections; L. O. Stewart, Secretary, Iowa Section; Lazarus White, Director Am. Soc. C.E., New York.

Section meetings during the year, and by Sections this attendance varied from half a meeting to over eight meetings. Only one Section held less than 5 technical meetings in 1939 and the average Section held 10 meetings, but the prize again goes to the Sacramento Section, which held its weekly luncheon meetings throughout 1939 in addition to field trips and social meetings.

In discussing the problems of administering a Section whose membership is scattered over all or a part of five states, President William W. Zass, of the Mid-South Section, recommended that study be given to methods by which assistance can be rendered to Sections in some proportion to their relative difficulties in rendering service to their members. Mr. Zass's paper is abstracted in another column of this section.

STATE COUNCILS OF LOCAL SECTIONS

The Board of Direction has indicated, as a fundamental concept of Society operation, that many phases of its activities must be decentralized and put into the hands of the Sections—for example, the passage, strengthening, and enforcement of registration laws; close cooperation with engineering colleges and the Student Chapters in them; improvement of the salary status of civil engineers, both in public service and in private employment; dissemination of appropriate publicity concerning civil engineers and their work; and the continuous improvement of the professional abilities and the ethical standards of its members. In a state that includes several Sections within its boundaries, some of these functions should receive the combined attention of all the officers of such Sections. Considerable conference discussion was devoted to methods by which state councils of Local Sections can be organized to work out such common problems.

H. F. Thomson, president of the St. Louis Section, believes there is need for a great centralization of engineering organizations, a coordination of the engineering point of view. In St. Louis there is a Joint Council of all the local sections of the national engineering societies represented in the city. The Council's general function is to handle engineering matters from the public point of view and to carry out social activities. The St. Louis Section of the Society has limited its own activities to technical meetings and excursions, which particularly apply to civil engineering instruction. "We can function locally without much need for a state council of Sections of our Society alone, but I believe a state council of all engineering organizations, such as American Engineering Council is giving us on a national basis, is very desirable," Mr. Thomson concluded.

According to R. P. Hoelscher, vice-president of the Central Illinois Section, the Illinois Engineering Council, with a membership of 17 or 18 local sections of national organizations, was organized about 1938 for the support of a proposed bill to license professional engineers. Although the bill failed to pass, the coordinated effort appears to have strengthened the organization. The council is preparing to take up the establishment of a civil service and a merit system for state highway engineers.

SUB-SECTIONS PROVE EFFECTIVE

The Texas Section has been notable for its Sub-Section or branch organization. It was the first Section to adopt this means of extending service to its widely scattered membership and to receive the approval of the Board of Direction for this form of organization. The Tennessee Valley Section also has adopted the same idea and now has Sub-Sections in Asheville, N.C.; in Chattanooga and Knoxville, Tenn.; and in Muscle Shoals, Ala. Concerning the success of the plan in the Texas Section, Secretary John A. Focht said:

"A number of years ago the members in Dallas felt they wanted to get better acquainted with each other and have a local group meeting. They organized and started a move for the Board's approval of Sub-Sections or 'Branches.' We now have four Branches in Texas. The constitution of the Texas Section provides that each Branch obligate itself to appoint three standing committees—a local membership committee, a local committee on public relations, and a local committee on professional welfare. The monthly branch meetings have excellent programs.

"In February the Student Chapter at Southern Methodist University was installed as an indication of the interest taken by our Branches. Over 40 members of the Dallas Branch were in attendance at the ceremony. For a situation similar to that in Texas, Branches or Sub-Sections are not only worth while but they are essential."

The Wisconsin Section includes a large portion of the state, but the Society members therein are resident in, and close to, two of the largest cities. Secretary Lloyd D. Knapp believes that an effective means of making the Society active in Wisconsin is to spread and extend the activities of the Section into every part of it in which civil engineers work. This Section is holding its meetings successively in the four or five principal cities of the state and anticipates that as interest and membership increase Sub-Section organizations will become worth while. An abstract of Mr. Knapp's paper appears in another column.

PUBLICITY FOR CIVIL ENGINEERS

"The people of this country seldom associate the works of the civil engineer with the civil engineering profession," said Secretary George W. Lamb, of the Kansas (State) Section. "One of the main purposes of our public information program is to educate the public to recognize an engineering project when they see or use one, and to realize that these projects are the accomplishments of the civil engineering profession." Mr. Lamb pointed out that a civil engineering accomplishment is not altogether the work of one civil engineer, but is the achievement of the many members of the profession who in past as well as present generations have contributed the knowledge that makes the project possible. Almost all of a civil engineer's time is devoted to planning and building adequate structures at the lowest possible cost to the users. Publicity should feature the economy, the savings, made possible by the civil engineer's efforts rather than the aggregate sum of money spent under his direction. He suggests the advantages to be obtained by newspaper reprints of abstracts of selected articles appearing in PROCEEDINGS and CIVIL ENGINEERING in acquainting newspaper readers with the work of the civil engineer. He believes that Sections should develop speakers who would offer to present—before clubs, schools, societies, and college students—information on the work of the profession.

LOCAL SECTION OPPORTUNITIES

In a busy day of presiding over Board meetings, speaking at the Chamber of Commerce, and broadcasting over the radio, President Hogan found time to stimulate the conference with his brief but pungent comments on the opportunities that lie within reach of the Sections to

Forecast of June "Proceedings"

MODEL TESTS, BRIDGE PIER, LONG STEEL PILES

By Thomas F. Comber, Jr., M. Am. Soc. C.E., and John M. Coan, Jr., Jun. Am. Soc. C.E.

Observational data to check existing theories or to supply a background for a new treatment.

THE PRACTICE OF STATE HIGHWAY DEPARTMENTS IN THE DESIGN OF ABUTMENTS

By a Subcommittee of the Committee of the Structural Division on Masonry and Reinforced Concrete

Analysis of a broad survey of current practice among highway engineers in the various states, the District of Columbia, and the Hawaiian Islands, as to soil analysis of foundations, compaction of backfill, supporting power of batter piles, a pile-driving formula, and the effect of buoyancy.

RECOMMENDED PRACTICE FOR THE USE OF CONCRETE AND REINFORCED CONCRETE

Report of a Joint Committee containing the accumulated efforts of 10 years of constant study, to produce detailed specifications for the use of the designer.

DISCUSSION OF PROCEEDINGS PAPERS

The press of discussion and the necessity for according considerable space to long symposia, has made it necessary to postpone the publication of some waiting papers. June "Proceedings," nevertheless, contains one valuable paper and two reports. It is expected that all available discussion, up to the dead line for the issue, will be included in this last publication preceding the July-August recess.

assist the profession in improving its capacity to benefit the public which it serves.

A brief résumé of President Hogan's remarks follows:

"When I was first a Director in the Society, nearly twenty years ago, a meeting of the Board of Direction lasted for three days. The whole Board took hours to examine each application for membership. Yesterday the Board finished its work in one day. To the local membership committees and the Board's Membership Qualification Committee has been assigned the important task of examining the qualifications of all applicants.

"I regard the work of the local membership committees as an important duty and trust. The functioning of these committees is generally good, but a man who applies for membership in this Society expects to have his application considered with reasonable promptness.

"Since becoming President of the Society, I have had the opportunity to visit at least 12 Eastern Local Sections and a number of Student Chapters. In the course of these visits I have received an impression of the improvements that have taken place in the past few years. The main advances in the Local Sections since I was a Vice-President, about five years ago, have been in publicity; in the growth of the Student Chapters; in the establishment of Junior Forums; and in the establishment of prizes by the Sections for both Junior and Student Chapter members. The Juniors are holding their independent forums, and the Student Chapters their regional conferences—both are delivering their own papers and discussing them. For the moral and financial support of these great activities, we must depend on the Local Sections. The work the Local Sections are doing among the Juniors and students is one of the most encouraging things in the whole Society.

"In all the Local Sections I have visited there is a strong movement to increase the Society's membership. I can find no disposition in the whole Society to lower the bars to admission even a fraction of an inch, but the movement that has started has been effective already. Applications so far this year are 30% above those at the same time last year. In Pittsburgh, I attended a dinner meeting followed by a smoker. At the smoker half the people present were guests of the Section—engineers whom the members had invited because they thought them eligible for membership and wanted them to find out something about what the Society is doing.

"This winter I spent a month in South America, the greater part of the time in Caracas. There the Society has 80 members—about 40 of them Venezuelans and about 40 Americans. Another 40 American members spend considerable time there but keep their addresses in this country. Most of these members are graduates of American universities. They get their technical inspiration from the Society. It is an important organization to them. They wish a Local Section there, and the Board, looking with favor on the idea, is studying it further.

"Our Local Sections are doing splendidly, but you who represent them must be prepared to take on a greater and greater burden of the management of the Society. In order to do that you must become more efficient yourselves. At present the Board is really a policy-making body, a reviewing body, with the Sections doing the work."

Secretary Seabury spoke of the committee and Board activities in Kansas City during the previous several days—the meeting of the Executive Committee, of the Committee on Membership Qualifications, the Committee on Publications, the Committee on Professional Conduct, the Committee on Technical Procedure composed of the chairmen of the Technical Divisions, the Committee on Society Meetings, the Committee on Engineering Education, the Committee on Salaries—all leading up to, or a result of, the meeting of the Board of Direction itself.

Administering a Geographically Large Section

Presented Before the Regional Conference of Local Sections, Kansas City, Mo., April 16, 1940

By W. W. ZASS

PRESIDENT, MID-SOUTH SECTION OF THE SOCIETY

THE MID-SOUTH Section includes all or a part of five different states in its area. The approximate distance by air line from its northern boundary to its southern is 450 miles and from its eastern boundary to its western, 360 miles. The total area involved is estimated at 115,300 sq miles. About 240 numbers, located within the limits of the Section, are assigned to it—one member per 480 sq miles of area. Of this membership, probably not over one-half can be deemed to have a permanent residence in the area; the rest are continually moving in and out of the area owing to the fluctuating demands of the agencies with which they are engaged. Three Student Chapters are included in the area—one in Arkansas and two in Mississippi—the travel distance between the extremes of location being about 400 miles.

The administration of a Local Section of this character presents problems not encountered in the administration of a more compact Section having a greater density of membership. It can be recognized that under the conditions mentioned a large share of the normal conduct of the affairs of the Section must be carried forward by correspondence rather than through informal discussion; that it is more difficult to keep contact with the membership and maintain a sustained interest in Section activities; that committee personnel is necessarily scattered if an adequate area representation is to be obtained, and that committee activities are consequently curtailed; that Section meetings must be fewer because travel distances are too great to promote frequent gatherings; that with a limited number of members in the Section adequate financing becomes burdensome; and that many desirable activities and functions become difficult of execution.

The Society should recognize that a basic and fundamental disparity exists between Local Sections, that all are not equal in facilities, and that some equalizing of benefits must obtain to place them within the needed condition of parity. Each Section has certain basic functions to perform regardless of its income or the number of its membership. An equal per capita service in the Section of lesser membership and greater area incurs a greater per capita expense than that which obtains in a Section of greater membership and lesser area.

Those Sections of considerable area and lesser membership should not be subdivided into smaller areas with a consequent further decrease of membership in each of the segments. The advantage of a sizable membership is apparent. Rather, the Society should recognize the difficulties inherent in administering a Section like the Mid-South Section and provide it with further assistance in order that it may function satisfactorily and efficiently. Properly the Society from time to time has decentralized activities, and has placed greater responsibility in the hands of the Section. The Sections are fully capable of assuming the added responsibility, but they must have tools to work with, and one of the major tools is adequate financing.

The Committee on Local Sections might well study methods and means whereby a greater parity of financial benefit to the Local Sections can be achieved than at present exists. This might be accomplished by means of a correction factor applied to the 1938 formula now in effect. If the index for a normal Section were given a weight of one, another Section in comparison thereto might be given a weight of 0.85 or of 1.10 as the case might be, and the basic formula corrected accordingly. Or the current formula might be revised to the extent that a considerably greater weight be given the Section as a standing unit, a ready-to-serve unit, a necessary functioning unit of the Society, than is now in effect.

Louisiana Section Establishes a Placement Service

Presented Before the Local Section Conference, Kansas City, Mo., April 16, 1940

By V. J. BEDELL

SECRETARY, LOUISIANA SECTION OF THE SOCIETY

IN CARRYING out the objectives of the Constitution of the Society, it becomes the duty of every Local Section to do its part in promoting the welfare of its members in a material way as well as in the advancement of their professional standing. During the past ten years, the engineering profession has suffered, along with all other professions and businesses, from prevailing economic

conditions. The younger engineers and recent graduates from our engineering schools have borne the brunt of the depression in that they have either been unable to obtain engineering work at all or else have obtained work of a temporary nature, being unemployed a large part of the time.

However, I believe now that if the field of engineering employment were thoroughly investigated in a systematic manner, with the proper cooperation of all Society members, there would be found professional or subprofessional employment for every civil engineer in the United States. By subprofessional employment is meant work on engineering projects, not necessarily in the engineering force of the project but as a time-keeper or even as a laborer or member of a craft employed on such projects. This class of work, if the employee is interested and willing and uses his power of observation to the fullest extent, will amost always lead to future employment on engineering work, as an engineer or in a supervisory capacity for the contractor. Such work is preferable to jobs that are not in any way connected with the engineering profession. The problem, then, is to assist the young man in contacting the supervisory engineer, contractor, or superintendent who may be able to use him in a professional or subprofessional capacity. The Local Section with a well-organized employment bureau can offer invaluable service to the engineer, particularly to the recent graduate who during his undergraduate life has probably been an interested and active member of a Student Chapter of the Society.

In the spring of 1939 the board of directors of the Louisiana Section, recognizing the necessity for some method of bringing the prospective employer and the prospective employee together, set up as a part of its regular organization an employment committee whose duty it is to establish an employment bureau for this purpose. In order to be able to furnish employers with the kind of men needed, it was necessary to have a complete understanding of the character and ability of each applicant. Consequently a questionnaire blank was developed, which was distributed to the members of the Local Section and of the Student Chapters. A greater part of the questionnaire referred to the training, habits, activities, and qualifications of student engineers and to the observations of the faculty concerning them, but it is designed to show as well the professional record of the experienced member together with a list of his employers.

At the same time all the contractors and engineers doing active work in the state of Louisiana were circularized and requested to apply to the Section's employment bureau for such men as they might need in professional or subprofessional work. Louisiana has a license law for contractors; hence from a list of all licensed contractors it was easy to select the names of the principal employers of civil engineers. Fortunately almost all the engineers holding key positions in Louisiana, both in public and private fields of endeavor, are members of the Society, and everyone did his part in an effort to place recent graduates. As a result practically all students were placed within three months of their graduation.

From time to time the employment bureau has also been able to place several older and more experienced engineers in lucrative positions. It is thought that as the work of the bureau progresses all contractors and employers of engineers will become acquainted with the facilities of the bureau, and it will be able to cope with the unemployment situation which has been a menace to the engineering profession in Louisiana for many years.

The successful operation of an employment bureau by a Local Section depends entirely upon the full cooperation of all members in advising the bureau of all vacancies for engineering employees of which they become aware and in calling upon the bureau to furnish men for their own organizations.

In this connection, efforts have been made by the Louisiana Section—and should be made by every Local Section—to the end that young engineers required in the highway department or other departments of the state should be taken from the graduate list of engineering schools. Contractors should be educated to the advantage of employing young engineers and breaking them in as foremen and superintendents. Not all men are physically and mentally equipped to be leaders or supervisors, but many who have such mental equipment are slow in finding their proper position in life due to the fact that no opportunity is given them to display their talents for leadership or supervisory work. If members of the Local Sections who are in key positions will make the effort, they can see to it that all Student Chapter members will find employment upon their graduation or very soon thereafter.

Junior Forums Needed for Self-Improvement

Presented at the Regional Conference of Local Sections, Kansas City, Mo., April 16, 1940

By L. O. STEWART

SECRETARY, IOWA SECTION OF THE SOCIETY

A DISCUSSION of Junior Forums for self-improvement should be divided into the following topical headings: (1) the need for Junior Forums; (2) organizing and carrying out the details; and (3) practical considerations and difficulties.

THE NEED FOR JUNIOR FORUMS

We are dealing here with a phase of adult education. That movement is growing in the consciousness of the general public, and it is gaining momentum. Thought and attention should be given to the possibility and practicability of making our activity effective within our own profession and as a part of this larger public movement. If we really wish to do that we must give our active support to public-spirited individuals and groups who are at work on the problem.

The "feeling of need," so necessary for the success of such a program, ought to be taken for granted but I fear that many of our members—corporate members as well as Juniors—must be sold on the idea. The first few years after graduation are very crucial in shaping the young man's career. For the first time he is free from all restraints and is largely on his own. Some constructive program of guidance is helpful during this period to take the place of the close relationship that exists in school between the student and his professor and that does not now exist between the young engineer and his chief on the job.

Our young men need the opportunity for effective practice in public presentation; they need practice in organizing and directing men and affairs, and in working with members of a group; they must learn the importance and the technique of making business and professional contacts; they need to keep up with the developments in their own and related professional fields; they should develop a civic and group consciousness that impels them to participate in the affairs of government. There is a need for Junior Forums.

ORGANIZING AND CARRYING OUT THE PROGRAM

The Junior Forum can be started by selecting a corporate member to act as adviser and organization chairman and to plan the first meeting. Thereafter arrangements should be in the hands of the Juniors. Inasmuch as continuity is so important and so difficult to maintain, it might be preferable to have a directing committee of Juniors in place of the usual president, vice-president, and secretary.

The programs should be the type that the young men would choose—technical or non-technical—and that offers opportunities for forum discussion. Formal presentation of long papers should be kept under control.

Meetings should be held frequently to maintain continuity of action and interest. Probably once a month is a desirable interval. A common procedure is to have the Junior Forum scheduled to meet on the same date as the Section and arrange for the Junior officers to report at the Section dinner which follows the Junior meetings. However, costs must be kept low.

PRACTICAL CONSIDERATIONS AND DIFFICULTIES

The programs must be well planned from the standpoint of scope and content, selection of participants, and advance scheduling of time, and everyone concerned should have ample opportunity to participate. These programs should not be handed out by older members as lesson assignments are given out by a teacher. The Juniors must be responsible.

A very real difficulty in some Sections is the scattering of Juniors over the territory in such a manner that the time and expense incident to travel discourage attendance at meetings. Certainly there is a minimum number that can carry on interesting and effective discussions—perhaps this is ten or a dozen.

To return to the question of adult education. One of the crying needs of all of us is the broadening influence that comes from close association with people outside our immediate field. There is an old saying to the effect that if the blind lead the blind they will

both fall into the ditch. Certainly we as members of the Society should do all that we can to promote the progressive professional development of our younger men by our own positive efforts. At the same time we should always be alive to the good that may come from our participation in broad educational programs.

Extending a Local Section's Influence

Sub-Sections as a Means of Increasing a Section's Service

PRESENTED AT THE REGIONAL CONFERENCE OF LOCAL SECTIONS AT KANSAS CITY, MO., ON APRIL 16, 1940

By LLOYD D. KNAPP

SECRETARY-TREASURER, WISCONSIN SECTION OF THE SOCIETY

THE SOCIETY took a decided step forward in the recent reorganization of Section boundaries. It was a move calculated to bring the Society closer to the membership. It has undoubtedly done so. By assigning all members of the Society to some Section, and by increasing the assignment of funds to the Sections, the Board of Direction has done about all that can be expected. From now on the problem is squarely up to the Sections.

It appears that the organization of Sub-Sections or branches offers one of the most effective methods of spreading Section and Society activities. It is easy to make such a statement, but more difficult to put such a plan into practice.

Civil engineers are concentrated in the larger cities, in the state capitals, in the college towns, in railroad centers, in the offices of our highway departments, and at the site of construction of great public improvements. We therefore find considerable variation in the distribution of Society membership throughout the various Sections. In the Wisconsin Section, for example, we have 90 members in Milwaukee, 40 in Madison (the state capital as well as the seat of the University of Wisconsin), and 30 scattered throughout the rest of the state. This is a small membership for a state with the population of Wisconsin, and our board of directors feel that our membership can be at least trebled.

Previous to the recent Section reorganization, the only Section in Wisconsin was in Milwaukee, and its influence covered only Milwaukee and nearby cities. Our first step under the new set-up was to establish the Wisconsin Section, and next to convince the members that the Section is a live state-wide organization. The administration was decentralized: the first vice-president was elected from Madison, and the committee members were selected from the whole state.

Two meetings a year are held in Madison, and all civil engineers in the area are invited. Good speakers and fine programs have attracted an average attendance of about 125. The Section has received much favorable comment as a result of these meetings, and membership in the Section is increasing.

In the eastern part of Wisconsin there are eight or nine cities with populations varying from 10,000 to 30,000 located within a radius of 30 miles. We intend to extend the service of the Society throughout this territory and eventually to have a substantial membership in the area.

Last fall a Section meeting was held in Green Bay where there are but four members. Seven members from Milwaukee drove 120 miles to attend this meeting, and the vice-president of the Section came all the way from Madison. It was a small meeting, but it was the first Society meeting ever held in the territory. This spring we will hold a meeting in Appleton where there are only two members, but all interested civil engineers will be invited to attend.

Before attempting the organization of Sub-Sections, it is imperative that Society activity and service be extended to, and member interest be stimulated in, the area under consideration. It is not to be expected that Society members at a distance will flock to meetings in the larger cities merely because they have been assigned to membership in the Section; the Society must move closer to the membership by meeting in the member's home town.

The Wisconsin Section is working toward the goal of Sub-Sections, but it is my belief that we should have at least three areas in which there are at least 30 members before attempting a tangible organization. I recommend the establishment of Sub-Sections where local circumstances permit and also the development of interest in areas where qualified engineers are resident in numbers sufficient to make the ultimate establishment of a Sub-Section worth while. Such a program will require the expenditure of time, money, and effort on the part of Section officers and members, but it is a program that will pay dividends.

Making the Salary Schedule Effective

With Special Reference to Mid-Western Conditions

ABSTRACT OF TWO PAPERS PRESENTED BEFORE THE LOCAL SECTION CONFERENCE AT KANSAS CITY, APRIL 16, 1940

An Analysis of Civil Engineering Employment in Nebraska

By ROY M. GREEN

PRESIDENT, NEBRASKA SECTION OF THE SOCIETY

AGREEMENT upon a proper salary to be paid for services rendered is no different from the equitable agreement that is necessary for any other fair and satisfactory transaction. Therefore, if the Society's salary schedule is to become effective locally one fundamental condition must be met—there must be an agreement between the parties rendering the services and those paying for the services that the services and compensations are equal in value and that neither party has taken an undue advantage of the other. A condition that either party believes is unfair cannot prevail indefinitely.

Before attempting to devise a means of making the salary schedule effective locally, we must therefore determine certain facts, as follows:

1. Who is rendering the services locally?
2. Who is paying for the services locally?
3. Do the parties rendering the services locally agree that the Society's salary schedule is equitable?
4. Do the parties paying for the services locally agree that the Society's salary schedule is equitable?
5. How can we best reach an agreement between the two parties that the Society's salary schedule is equitable?

I will attempt to outline briefly the answers for the foregoing so far as the Nebraska Section area is concerned.

Who Is Rendering the Services Locally? The last directory of the Society shows that there are 120 members within the area of the Nebraska Section ranging in rank from Juniors to full members. An incomplete study of the total number of persons offering their services in civil engineering in Nebraska shows a total of 858 men, but I am convinced that there are at least 1,000 men competing for civil engineering employment within the Section's boundaries.

Who Is Paying for the Services Locally? Data have been collected upon the 858 men just mentioned. An analysis of their places of employment shows the following:

Federal government	81	9.4%
State government	397	46.2%
Political subdivisions	262	30.5%
Private industry and private practice	118	13.9%
Total	858	100.0%

While the study of type of employers of members of the Society as given in the February 1940 issue of CIVIL ENGINEERING shows that 55.6% of the members are employed by all types of governmental agencies, in Nebraska the survey shows that 86.1% are employed by governmental agencies of all types.

Do the Parties Rendering the Services Locally Agree That the Society's Salary Schedule Is Equitable? We should face this situation squarely and admit that there are many men in the list of the 858 who do not know what the Society is doing, and even less

realize that it has published a salary schedule. To illustrate—the Nebraska Engineering Society has maintained a placement bureau during the past two years. In a typical announcement, published in the last circular of information, a civil engineering graduate, 39 years old, a registered professional engineer with 18 years' experience in supervising highway and irrigation projects, and in private practice, offers his services at $150 per month.

If the statement of education and experience is correct, this civil engineer would conservatively fall within Grade II of the salary schedule and should probably be near the top of that grade. The Society's salary schedule would indicate that the compensation should be from $250 to $260 per month, and that $220 per month would certainly be the minimum salary. He has, therefore, evaluated his services at from $70 to $110 per month less than the schedule. While this lack of knowledge is not universal, it would probably be safe to say that at least 500 of the 1,000 men under discussion have about the same kind of understanding of the value of their services.

Do the Parties Paying for Services Locally Agree That the Society's Salary Schedule Is Equitable? In Nebraska 86.1% of the civil engineering talent receives its salary from the people in general—that is, the taxpayers. If the civil engineers offering their services do not have an appreciation of their worth, how can we expect the public to appreciate their value? It would appear obvious that the public has no conception of the value of engineering services.

How Can We Best Reach an Agreement Between the Two Parties That the Society's Salary Schedule Is Equitable? Both the engineering employees and the taxpayers must be educated before the Society's salary schedule can even be proposed as a fair basis for compensation. The first group to educate is the engineering employees themselves. This is a very difficult task, because only a small proportion of such a group will recognize any common cause other than the individual's economic condition. This is too individualistic to serve as a common meeting ground, because there is competition on a price basis, and each individual has apparently come to the conclusion that "half a loaf is better than no bread." A logical and sound procedure for educating this heterogeneous group is a challenge to the Society and its Sections.

If and when a workable understanding of the value of their services is realized by the employed engineers, the task of educating the public to the same appreciation then arises. This might appear to many to be a much harder task but, in my opinion, it is the easier one if we can accomplish the first. We already have the necessary guide for our procedure given us by the program of the Engineers' Council for Professional Development, which I will briefly outline. It includes: (1) vocational guidance; (2) cooperation by the profession with the institutions teaching engineering—a part of which is the accrediting program; (3) professional development among the younger engineers, resulting in their being legally recognized by registration; and (4) professional recognition, which will result from the program, and which includes appropriate publicity for engineers such as the Society is encouraging.

In Nebraska, vocational guidance has started with a real program, which is being sponsored by the Nebraska Engineering Society and the various local engineering clubs. Accrediting is being accomplished by E.C.P.D. Further cooperation of the profession with the educational institutions should be undertaken by the local sections of the Founder Societies, and these sections should also encourage and foster professional development. Professional recognition is a task for both the local and Founder Societies.

Except in a very few situations, the salary schedule can be made effective locally only after a long educational period, since the employer of the greatest number sets the pattern of compensation for others. These few exceptional situations should be worked upon vigorously and immediately.

Salaries for Civil Engineers in Missouri

By W. G. FOWLER

SECRETARY-TREASURER, KANSAS CITY SECTION OF THE SOCIETY

IN THE PRECEDING paper Mr. Green has clearly stated the problem of making the Society's salary schedule effective locally and has set forth a general solution to which I heartily subscribe. A few facts in connection with conditions in and around Kansas City (Mo.) may be of interest. Employers of engineers in this territory can generally be classified as follows: the federal government, the state government (mostly state highway), city and county, consulting engineers, railroads, industrial corporations, and miscellaneous.

The engineering salary schedules set up for the employees of the federal government are generally approximately equal to those established by the Society.

The salaries of the engineers in the employ of the state government, consisting mainly of highway employees, are generally below those of the Society's schedule. This is also true of the employees of the city and county. In these cases the employer is the general public, and a program of education of the public appears to be a necessity if advancement is to be made. A civil service or merit system arrangement, properly set up, carrying approved salary schedules and rigid enforcement, would be highly desirable. For a number of years Kansas City has had a civil service provision in its charter, but it has been consistently ignored by the officials in power. We have recently installed a new set of city officials pledged to support the charter, including the civil service provisions.

In the consulting engineering field there is a different problem. The salaries of engineers employed by the consultants are generally lower than those established in the Society's schedule. Yet the consultants themselves are keenly aware of conditions prevailing in the profession and are anxious to do all within their power to advance the status of the engineer. As a matter of fact the cause of their present problem is easy to find. Consultants' fees have, to a large extent, been established by tradition and precedent over a period of years when economic conditions were different from those now existing. When a consultant pays out a dollar in salaries, he must take in at least a dollar in fees. A move was made toward rectifying the fee difficulty when the Society issued its Manual No. 5 entitled, "Charges and Method of Making Charges for Professional Services." The recommended fees set forth in that manual were, in many cases, somewhat higher than those previously established by custom, and these proposed fees would go far toward making it possible for the consultant to pay salaries comparable to those set forth in the Society's schedule. To enforce the Society's fee schedule, concerted action on the part of the consultants will be necessary, because as long as one or two of them in a locality make a practice of doing work at low fees, no increase in fees is possible.

Salaries for engineers in the employ of railroads varies considerably with general business conditions. It seems feasible, considering the relatively small percentage of engineers in railroad employ as compared to the total number of railroad employees, to take steps to stabilize engineering salaries more than has been done in the past, without working a hardship on the railroads.

In the industrial field we find the greatest variation in salaries and, almost without exception, they are below the Society's schedule. The salaries in the steel fabricating plants are probably higher than in corporations and companies engaged in other businesses, and are usually as high as can be paid under the competitive conditions prevailing in that field. Many companies in other lines of work, that employ only a few engineers as general maintenance men, look upon these engineers as relatively unimportant. This field is complex, but an illustration may be illuminating. One large corporation in the general merchandising business in the Kansas City territory offers, among other things, free drafting service to customers in connection with the sale of heating plants and plumbing supplies for homes. They have a graduate engineer who handles this work in addition to doing all the drafting and designing incident to new construction and maintenance in a plant covering some forty acres. He has been employed by this company for several years at a salary of $125 per month and probably will never receive more there. Yet this civil engineer could qualify under Professional Grade II of the Society's schedule, which carries a rate, even for the lowest in that grade, of nearly $100 per month more than he now receives. The solution which presents itself is for the engineering profession to take concerted action to educate non-technical employers of engineers so that they will have a fuller understanding of the fair value of engineering services.

While there has been a material improvement in the last twenty years in the financial status of the engineer, brought about to a large extent through the activities of the engineering societies in giving the general public a better knowledge of how engineers serve it, much remains to be done.

Regional Student Conferences Held

Interesting Programs Presented at Spring Gatherings at Colleges

Regional Student Chapter Conferences held under the auspices of the Society's Committee on Student Chapters are in a flourishing condition. There are now 14 such conferences in which the Chapters in a convenient area take turns as host. In many respects the conferences are similar to Society meetings on a small scale. Their planning and management are entirely in the hands of student officers and committees. The 11 reports submitted below contain many evidences that these students have handled their responsibilities well. They are to be sincerely congratulated for their good work.

CAROLINA—APRIL 19–20

The spring meeting of the Carolina Conference of Student Chapters was held on April 19 and 20 at The Citadel, Charleston, S.C., with The Citadel Chapter as host. Representatives were present from the Chapters at Duke University, North Carolina State College, the University of South Carolina, Clemson College, and The Citadel.

The Conference opened on Friday afternoon with registration and a period for getting acquainted, followed by a full-dress parade of the Cadet Corps of The Citadel. After supper in the Mess Hall Annex the executive committee met. Later in the evening all attended an informal dance in the auditorium, for which Mrs. J. B. Gaston was hostess.

The Saturday morning session was opened by General Summerall, commandant of The Citadel, who welcomed the Conference. W. Mack Angas, Commander, Civil Engineer Corps, U.S. Navy, then gave an address. This was followed by the presentation of student papers in a competition, after which the executive committee convened for its final actions.

Following the evening banquet in the Mess Hall, Toastmaster "Sally" Crouch introduced the guest speaker, W. W. Wannamaker, Jr., President of the Association of Citadel Men. Then Col. John Anderson, faculty adviser for the Host Chapter, presented the awards for the prize papers. First prize went to William J. Koob, of The Citadel, for his paper on "Military Engineering"; second prize to Howard Smith, of North Carolina State College, for his paper on "Elimination of Street Intersection Hazards"; third prize to J. Q. Lever, of Clemson College, for his paper on "Coordinate System of Land Survey"; fourth prize to William F. Groesbeck, of Duke University, for his paper on "Underpinning a Chimney"; and fifth prize to F. D. Shuler, of the University of South Carolina, for his paper on "Soil-Cement Stabilization."

The officers of the Carolina Conference for 1941 were announced as H. W. Fox, of North Carolina State College, president; D. F. Newton, of The Citadel, vice-president; and E. H. Lesesne, of Clemson College, secretary-treasurer. It was also announced that the former custom of two meetings a year would be discontinued in favor of a single spring conference. The next meeting will be held at North Carolina State College in March or April 1941.

The Conference officers responsible for the meeting were J. R. Liles, of Clemson College, president; E. H. Johnson, of North Carolina State College, vice-president; and J. D. MacLauchlan, of Duke University, secretary-treasurer. Data for this article were furnished by Secretary Lesesne.

MARYLAND–DISTRICT OF COLUMBIA—APRIL 26

The George Washington University Chapter was host to the Fifth Annual Conference of the Maryland–District of Columbia Student Chapters on April 26. There were approximately 75 present from the Chapters at Johns Hopkins University, the University of Maryland, the Catholic University of America, and George Washington University.

This was the second time that the host Chapter had entertained the Conference, and in the intervening four years of experience a smooth-working and uniform procedure has been evolved. The improvements have been facilitated by amendments to the Conference constitution, making it a concrete and workable instrument. For example, the officers of the host Chapter serve on the executive committee that year and are assisted by a local committee, thus reducing the load on the president and secretary of the Chapter. Correspondence between the Chapters results in obtaining a program in accordance with the desires of the Chapters.

FIFTH ANNUAL CONFERENCE OF THE MARYLAND–DISTRICT OF COLUMBIA STUDENT CHAPTERS

The Conference was preceded by a January meeting of the executive committee—which is highly recommended as a working procedure.

The Conference itself was called to order Friday morning by Harry O. Wright, chairman of the executive committee. Dean Frederick M. Feiker, of the school of engineering at George Washington University, delivered the address of welcome, and there were responses by the presidents of the participating Chapters—W. Stewart McKay, of Johns Hopkins University; E. Kent Bebb, of the University of Maryland; and Robert Viner, of the Catholic University of America.

Field Secretary Jessup brought greetings from the Society and reported the activities of the Student Conference held at Kansas City during the previous week in connection with the Spring Meeting of the Society. The University of Kansas Chapter acted as host to the Conference. Mr. Jessup announced that a similar meeting would be held in Baltimore in April of 1941 and suggested that the Maryland–District of Columbia Conference could effectively serve as hosts. In the business meeting that followed it was voted to offer the services of the Conference as host to the Baltimore Student Chapter meeting, and the Johns Hopkins Chapter was asked to study the possibilities.

Forrest Allen, of the Federal Works Agency, then showed motion pictures of the demolition by blasting of the Boulevard Apartment House in Washington, with running comment by H. G. Hunter, assistant to the Commissioner of Public Buildings. Then Donald H. Sawyer, Past-President of the Society, spoke on "The Human Relations of Engineering," stressing the country's need for broad, cultured engineers, and the engineer's need for the Society.

Following a buffet luncheon on the campus, there was a choice of inspection trips—one to the hydraulics laboratories of the Bureau of Standards and the Naval Testing Basin at Carderock,

Md., the other including inspection of the foundations for the new War Department building, the building materials exhibit at the Federal Warehouse, and the advanced stages of construction of the National Airport at Gravelly Point.

George O. Sanford, of the U.S. Bureau of Reclamation, acted as toastmaster at the annual dinner, which attracted many distinguished guests from the District of Columbia Section and the staffs of the participating colleges. It had been requested by the Student Chapters that the feature address be in a non-engineering field and this was happily accomplished by Merle Thorpe, editor of the *Nation's Business* and trustee of the George Washington University, who spoke on "What of Tomorrow's Business?"

This article was prepared by Harry A. Balmer, secretary of the host Chapter and of the Conference.

METROPOLITAN—APRIL 16

One hundred and fifty students of civil engineering, representing the Student Chapters of the Metropolitan (New York) District of the Society, attended the annual Spring Conference of the Metropolitan Student Chapters at Cooper Union on April 16. Attendance by Chapters was as follows: Brooklyn Polytechnic Institute, 2; Cooper Union, 53; Manhattan College, 5; College of the City of New York, 25; New York University 24; Newark College of Engineering, 14; Rutgers University, 1; faculty advisers, contact members (senior and junior), and guests, 26.

The afternoon meeting was called to order by Frank T. Griffin, of Manhattan College, chairman of the executive committee of the Metropolitan Conference, and immediately turned over to John D. Hanft, president of the Cooper Union Student Chapter. Mr. Hanft introduced Prof. George F. Bateman, dean of the engineering schools, who heartily welcomed the visitors to Cooper Union. The main address of the afternoon was given by Dr. Edwin S. Burdell, Director of Cooper Union, who in his talk on "The Engineering Curriculum," presented an analysis of what should constitute the training of the engineering student.

Speaking from his vantage point as a member of the Society for the Promotion of Engineering Education Committee on Aims and Scope of Engineering Curricula, Dr. Burdell pointed out the definite need for the inclusion of humanities in the engineering curriculum. However, he did not think that this calls for the much-discussed two-year pre-engineering arts course. It is his opinion that, while some engineering subjects might be displaced by the inclusion of humanities in a four-year course, such technical subjects might better be taken in graduate work, particularly as present-day industry is placing so much emphasis on graduate study. In reply to the often-repeated suggestion that the engineering schools should reduce their enrolment in order to ease the crowded situation in the technical field, Dr. Burdell stated that no test for engineering aptitude has ever been devised to sieve the chaff and leave only the particularly gifted engineering student, mere mathematical ability being no indication of a student's possible engineering prowess. Dr. Burdell's talk was enthusiastically received and provoked much student discussion.

After adjournment, a thorough inspection of the various laboratories was made.

Mr. Griffin called the evening session to order and then turned the meeting over to Sidney Weniger, Cooper Union member of the sub-committee charged with formulating the program of this Spring Conference. The first speaker was J. Charles Rathbun, associate professor of civil engineering at the College of the City of New York, who regaled the students with many humorous anecdotes of his experiences in the Far East, stressing particularly the adventure and romance of engineering in China.

Edward S. Sheiry, head of the civil engineering department of Cooper Union, corroborated Professor Rathbun's rather pessimistic viewpoint on the possibility of obtaining foreign employment. Speaking with particular reference to Turkey, where for eight years he was head of the department of civil engineering at Robert College in Istanbul, Professor Sheiry told of how the Turkish government made a practice of calling in American engineers only long enough to teach the Turkish technicians the ways and means of a particular project. Such a procedure is also followed in other countries of the Far East, Professor Sheiry stated.

Undaunted by the apparent lack of engineering opportunities in the Near and Far East, the students cheerfully lit up the cigars that had been distributed and proceeded to pepper the two speakers with questions ranging from engineering to politics.

This report was written by John D. Hanft, president of the Cooper Union Student Chapter.

MID-WEST—MAY 3 AND 4

With the Student Chapter at Armour Institute and the Illinois Section as hosts, the Third Mid-West Conference of Student Chapters of the Society met on Friday and Saturday, May 3 and 4, at the Institute. Six Chapters were represented, from each of which at least one student and the faculty adviser attended. In all, 53 students were present at the conference—from the Armour Institute of Technology, University of Illinois, Lewis Institute, Northwestern University, Purdue University, and Rose Polytechnic Institute.

The initial session, held in Armour Institute's Mission Building Assembly Hall, was presided over by George P. Hanna, president of the Chapter. The conference was welcomed by the Institute's vice-president, Linton E. Grinter, M. Am. Soc. C.E., who explained the purposes and objectives of the meeting. Pointing out that this was the third such meeting in this area of a series started by the Lewis Institute Chapter in 1938, he suggested that the time was ripe to consider the formation of a permanent organization of the member Chapters, to arrange the programs for, and to handle the details of, the yearly meetings. Dr. Grinter emphasized the importance of keeping up with progress in one's chosen field by joining the Society after graduation. Field Secretary Jessup spoke on the conference plan and described the Mid-Continent Conference held in Kansas City.

Friday morning's session continued with an interesting talk on the "Land Use Survey," by Eugene S. Taylor, engineer of the Chicago Plan Commission. Mr. Taylor's talk, as the title implies, was on zoning, efficient use of urban land, and planning for future city growth. The second talk of the day, given by Dick Van Gorp, assistant subway engineer in the design section of the Chicago Subway, on "Building Chicago's First Subway," was illustrated by slides showing actual construction methods being used on the tubes. This lecture proved of particular interest because of the impending afternoon inspection trip to that section of the subway being built by Paschen Brothers under the river along Milwaukee Avenue.

As guests of the Illinois Section, the conference met for luncheon at the Chicago Engineers Club. Over one hundred were present to see J. de N. Macomb, president of the Section, present awards of Junior membership in the Society to the following members of Student Chapters: Allen Roy Shackleton, of Purdue University; Chancellor D. Montgomery, of Rose Polytechnic Institute; Louis Worley Schumm, of the University of Illinois; George P. Hanna, of Armour Institute; Donald M. Graham, of Lewis Institute; and Mark Gantar, of Northwestern University.

A thrilling experience to most of the group was the trip through the air-lock into the subway construction itself. One atmosphere of pressure was enough to remind the neophytes that even ears passed as normal by the attending physician are sensitive to pressure changes. The engineer in charge conducted the party through the whole operation of cutting away the clay at the heading, setting the steel supports immediately following, erecting the steel forms for the concrete lining, and filling the forms with pumpcrete.

A dinner meeting of the Illinois Section at the Engineers Club completed the day. President Macomb, who presided, introduced City Engineer Loran D. Gayton, M. Am. Soc. C.E., who gave a fascinating illustrated lecture on "Underground Chicago," a historical presentation of the civil engineer's part in tunneling through the clay and rock beneath the city for the water intakes, sewage collection and disposal, the water treatment plant, the freight tunnels under the Loop-district streets, and finally the transportation subways being built under the downtown streets and the Chicago River.

On Saturday morning the conference convened again. The two delegates from each attending Chapter who had been selected to consult on the organization of a permanent conference elected the following temporary officers: president, John L. Donoghue, of Armour Institute; vice-president, Richard Simonsen, of Lewis Institute; and secretary-treasurer, Leroy Goetz, of Armour Institute. To this group with their faculty advisers was delegated the work of perfecting a constitution and presenting it to the member Chapters for approval by mail.

Following the business session, Prof. John C. Penn, M. Am. Soc. C.E., presented a lecture on the government subdivision of the public land in a paper entitled "Early Instructions to Surveyors." This was followed by an illustrated address on "Foundation Problems—Mexico City," by Albert E. Cummings, M. Am. Soc. C.E.,

a fascinating story of the peculiar characteristics of the clay which underlies the valley in which Mexico City is located, and the application of the civil engineer's improved knowledge of soil mechanics to the problem of using this clay as foundation material.

The conference adjourned to meet in April 1941 in Chicago, the exact date to be selected to best suit the schedules of participating Chapters. The Armour Institute Chapter, which will act as host, promises an attractive and interesting program.

This account is from data furnished by Leonard Elgenson, secretary of the Armour Chapter.

NEW ENGLAND—APRIL 26

REGISTRATION for the third annual meeting of the New England Student Chapter Conference began at one o'clock on April 26, 1940, at Worcester Polytechnic Institute, Worcester, Mass. At that time 116 persons, representing ten Chapters, were registered as follows:

Brown University	10	Norwich University	11
Dartmouth College	2	Rhode Island State College	13
Harvard University	3	University of New Hampshire	8
Massachusetts Inst. of Technology	13	Worcester Polytechnic Inst.	35
Northeastern University	19	Yale University	2

The Chapters at Tufts, the University of Maine, and the University of Vermont were not represented.

Donald R. Bates, president of the Worcester Polytechnic Institute Chapter, called the first session to order at 2 p.m.

Wat Tyler Cluverius, president of Worcester Polytechnic Institute, welcomed the visitors to Worcester and to the campus. In a brief address Admiral Cluverius emphasized some of the added social and civic responsibilities that are coming to the engineering profession.

After the address of welcome, the meeting was open for business. It was decided that a simple solution to the financial management of the Conference would be the election of one of the faculty advisers as permanent treasurer of the Conference, and Prof. A. D. Taylor, of Norwich University, was elected. It was then voted that the 1941 Conference is to be held at Brown University.

Next on the program was the presentation of student papers in competition for the Northeastern Section Student Prize Contest. Because of the large number of entries, each paper was abstracted to ten minutes for presentation before the Conference. The papers were judged on the basis of 60% for content and 40% for presentation. Fredrick H. Fay, Arthur D. Weston, and Miles N. Claire, Members of the Northeastern Section, served as the judges for the competition. The eight contestants and their subjects were as follows: Richard A. Coleman, of Worcester Polytechnic Institute, "Esthetic Bridge Design"; Daniel J. Coonan, of Rhode Island State College, "An Investigation Report on the Jamestown Bridge Foundations"; Richard J. Eberle, of Massachusetts Institute of Technology, "Elements of Photoelasticity"; J. Bruce Espy, of Dartmouth College, "Produce Refrigeration in Transit"; Walter B. Kelley, of Northeastern University, "Laying 11½-Ft Concrete Pipe Across the Sudbury River"; Willard C. Robinson, of Yale University, "Prefabrication in Low Cost Housing"; Harry A. Schendel, Jr., of Norwich University, "Insulation"; and R. H. Skelton, of Yale University, "Boundary Control."

After the presentation of the papers the meeting was adjourned to permit inspection trips to the Worcester Sewage Disposal and Treatment Plant, the Alden Hydraulic Laboratory, and the plant of the Norton Company, the world's largest manufacturer of abrasives.

That evening a banquet was held in Sanford Riley Hall on the campus. Walter H. Sodano, a member of the Worcester Student Chapter acting as toastmaster, introduced C. W. Banks, president of the Northeastern Section. After explaining the method of judging the papers, Mr. Banks presented the awards in the student prize contest. First prize, consisting of the entrance fee as a Junior in the Society plus $20 in cash, went to Mr. Espy. Second prize, consisting of the entrance fee as a Junior in the Society plus $10 in cash, went to Mr. Kelley. Messrs. Coleman and Eberle tied for third place, and each was awarded a third prize, the entrance fee as a Junior.

Mr. Sodano then introduced Charles M. Allen, professor of hydraulic engineering at Worcester Polytechnic Institute, who gave an interesting demonstration and lecture on "Gasoline, Its Use and Abuse." The Conference adjourned at the close of the banquet.

The Conference committee consisted of Richard A. Coleman, chairman, and Donald S. Denio, Clinton A. Gerlach, Paul G. Nystrom, and Walter H. Sodano. This report was prepared by Russell W. Parks, secretary of the Worcester Chapter.

PACIFIC NORTHWEST—APRIL 26–28

The Student Chapter at the University of Washington sponsored the first Pacific Northwest Regional Conference for the five chapters in that area on April 26, 27, and 28.

The Pacific Northwest area covers an immense territory, so that all visiting delegates must travel great distances for any type of get-together. For this first annual conference the Montana State

GROUP ATTENDING PACIFIC NORTHWEST STUDENT CONFERENCE ENJOYS BOAT TRIP

College students traveled 750 miles each way, the Washington State College and the University of Idaho groups covered 350 miles each way, and the delegation from Oregon State College trooped 285 miles up and back. Thus traveling to the Conference

NEW ENGLAND STUDENT CHAPTER CONFERENCE HELD AT WORCESTER POLYTECHNIC INSTITUTE

entailed heavy expense and considerable time. However, some of the groups stopped at Grand Coulee Dam, the Roza Project near Yakima, Rock Island Dam, and the Walla Walla Sewage Disposal Plant to break the monotony of their long trip.

All the visitors arrived in Seattle Thursday evening, April 25, were registered, given maps and programs, and assigned rooms in various hotels in the downtown area. On Friday morning the first event was a tour of the Bethlehem Steel Mill, which was rolling $^{1}/_{8}$-in. material. This was followed by a trip through the Henderson Street sewage disposal plant. After lunch there was a trip to view the construction of the Ballard Bridge, a visit to the locks at Ballard, and a tour of the University of Washington campus.

At the banquet Friday night with the Seattle Section 119 students and others heard a timely talk by Maj. John D. Corkille, chief test pilot for Boeing, who related many of his experiences while flying, and discussed the future of aviation. Previous to this, E. A. Loew, dean of the engineering college of the University of Washington, welcomed the visiting delegates; Cotton M. Howard, president of the Seattle Section, extended the Seattle's Section's best wishes for a successful conference; Fred Rhodes, Jr., faculty adviser for the host Chapter, introduced the visiting professors, and Roger Kolm, president of the University of Washington Student Chapter, introduced the officers of the visiting Chapters. Two pocket slide-rules were given as door prizes to the banqueters.

INDIVIDUAL NAME BADGE ORIGINATED BY PACIFIC NORTHWEST STUDENT CONFERENCE

On Saturday morning the Lake Washington Pontoon Bridge and Tunnel were inspected, and after lunch the group was taken on a boat trip around the piers of the Tacoma Narrows suspension bridge, as shown in the accompanying photograph. This was a special treat for the students from the inland Chapters. Later there was a trip to McChord Field, a new army air base at Tacoma.

The banquet with the Tacoma Section on Saturday evening was attended by approximately 90. The crowning feature of the evening was a talk given by Clark H. Eldridge, chief engineer of Tacoma Narrows Bridge. Colored motion pictures by Henry Foss showed the construction in progress. Everyone agreed that the combination made a wonderful program for a civil engineering banquet.

Since a few of the students wanted to get an early start home Sunday morning, the attendance at the inspection of the Stevens (Mud Mountain) Dam and spillway was only about 60. Upon completion of the inspection of this project the various groups said goodbye and started home.

The attendance was as follows: Oregon State College, 29; Washington State College, 19; University of Idaho, 12; Montana State College, 5; and University of Washington, 50.

Those in charge of arrangements were: general chairman, Roger E. Kolm; correspondence and arrangements, Fred L. Hotes; banquet, Jack Viele; lodging, Vern Meissner; laboratory tour, Cameron Smith; speakers, Bob Bullock; and field trips, George Chica, Dick Pearse, Ed Doolittle, and Jim McEwing.

This report was prepared by Roger E. Kolm, president of the University of Washington Chapter, who added: "Speaking for the University of Washington Chapter, I am sure that all our members had a swell time planning this first meeting of its kind ever held out in this section of the country, really enjoyed meeting the various other civil engineering students, and hope that this will be the start of an annual get-together that will grow bigger and better as the years roll by."

PHILADELPHIA—APRIL 22

The Sixth Annual Student Chapter Conference sponsored jointly by the Philadelphia and the Lehigh Valley Sections was held at the Pennsylvania State College on April 22. There was an attendance of 106 students, faculty members, and guests who assembled on Sunday evening for an acquaintanceship meeting in the form of a smoker. There were selections by the Penn State Glee Club and other entertainment.

When registration was completed, the representation stood as follows:

	Students	Staff
Bucknell	9	2
Drexel	8	1
Lafayette	6	1
Lehigh	3	1
Penn State	26	8
Princeton	2	.
Swarthmore	4	1
Univ. of Delaware	14	3
Univ. of Pennsylvania	5	1

There were present also 11 guests. No representatives were present from the Chapters at Villanova or Pennsylvania Military College.

Preceding the morning session on Monday, inspection groups were escorted through the engineering buildings. J. K. Hess, president of the Pennsylvania State College Student Chapter, then called the meeting to order. After a warm welcome by H. P. Hammond, dean of engineering at Pennsylvania State College, W. H. Chorlton, past president of the Philadelphia Section, responded for the Philadelphia Section and Prof. M. O. Fuller responded for the Lehigh Valley Section. Then followed an address by Prof. H. K. Preston, chairman of the Philadelphia Section's Committee on Student Chapters.

Six student papers were then presented, the high standard of which made judging difficult.

First prize of $20 in cash and payment of entrance fee and first year's dues as a Junior in the Society was awarded to Lawrence M. Mead, Jr., of Princeton University, for his paper entitled "Progress Report on Model Analysis of Passaic River Bridge."

The second prize, consisting of payment of entrance fee and first year's dues as a Junior in the Society, was awarded to J. Kenneth Hess, of the Pennsylvania State College, for his paper entitled "Ethics for Engineering Students."

The third prize, consisting of payment of the entrance fee as a Junior in the Society, was awarded to Sidney Robin, of Drexel Institute of Technology, for his paper, "Harnessing the Tides to Produce Electric Power." The first two prizes were awarded by the Philadelphia Section; the third by the Lehigh Valley Section.

Other excellent papers presented were "Use of Mechanical Models in Investigation of Transverse Forces on Building Frames," by Mariano Schifalacqua, of the University of Pennsylvania; "The Use of Price Trends in Public Utility Valuation," prepared by Alfred T. Cox and read by W. R. Clark, of Lehigh University; and "An Investigation of the Shenandoah Subsidence," by Charles F. Millard, of Bucknell University. The board of judges who graded the papers consisted of H. R. Rights, Charles Haydock, and Harry J. Engel.

After luncheon W. L. Schlager, of the Penn State Chapter, chairman for the afternoon, introduced C. E. Smith, vice-president of the New York, New Haven and Hartford Railroad Company, who spoke on "Opportunities in Industry." Mr. Smith predicted that the responsible positions of today will shortly be available to the men who have prepared themselves through technical training and experience.

Following Mr. Smith's address, Prof. H. K. Preston presented the award to the successful students, and the meeting was adjourned.

Altogether the Conference was a great success. Too much cannot be said of the excellent papers submitted, the hospitality of the Pennsylvania State Student Chapter and faculty, and the support of all those concerned in making this undertaking possible. In addition the wives of the Penn State faculty members provided entertainment for the visiting ladies. Prof. J. S. Leister, faculty adviser for the host Chapter, and the Penn State Student Chapter are to be congratulated. The next Conference will be held at Princeton University in 1941.

This article was prepared from reports by E. L. Shoemaker, assistant secretary of the Philadelphia Section, and by Professor Leister.

ROCKY MOUNTAIN—MAY 4

Just as this issue goes to press word has been received that the fourteenth Student Chapter Conference has been formed among a group of Rocky Mountain Student Chapters. On May 4 a meeting of representatives from the Chapters at the University of Wyoming, Colorado State College, and the University of Colo-

rado met at the University of Colorado to form a nucleus for the new group, anticipating that other Chapters in the vicinity may wish to join at an early date.

The representatives present at the meeting adopted a constitution, selected the University of Wyoming for a meeting in the spring of 1941, and elected conference officers. The chairman for 1940–1941 is Charles E. Boyers, of the University of Wyoming; the vice-chairman is Milton Moreland of Colorado State College; and the secretary-treasurer is Harold Saunders of the University of Wyoming. A tentative program was set up, consisting of a business session in the morning and an inspection trip in the afternoon. Other Chapters in the vicinity are cordially invited to consider membership in the conference.

Data for this report were furnished by Prof. C. L. Eckel, faculty adviser to the University of Colorado Chapter.

TEXAS—APRIL 26–27

The third conference of the Student Chapters in Texas was held at the time of the spring meeting of the Texas Section at Galveston, April 26–27. With 63 students present from the Chapters at Rice Institute, Texas Technological College, Southern Methodist University, the Agricultural and Mechanical College of Texas, and the University of Texas. The practice of holding joint Section and Student Chapter meetings has been notably successful since this Student Conference was formed just a year ago. Conferences are held twice a year.

Under the chairmanship of Joe Battle, president of the University of Texas Chapter, the Conference opened on Friday with the presentation of student papers in competition for prizes awarded by the Section. Five papers were presented as follows: "Construction Experience," by J. R. Sims, of Rice Institute; "The Effect of Transverse Reinforcing Steel in Reinforced Concrete Slabs Loaded with Concentrated Loads," by Thomas Crist, of Southern Methodist University; "The Fluoride Ion as a Problem in Texas Water Supply," by Burleson Graham, of the University of Texas; "Surveying in Texas," by John R. West, of the Agricultural and Mechanical College of Texas; and "The Design of an Impounding Reservoir for City Water Supply," by Martin Kuykendall, of Texas Technological College. The papers were judged by a committee consisting of E. N. Noyes, chairman, Director E. S. Bres, and W. H. Lilly. The committee reserved decision, and the group adjourned to join the technical session of the Section.

The student group with their "dates" were invited to the dance and demonstration of folk dances, which followed the Section banquet on Friday evening.

On Saturday morning the customary student breakfast sponsored by the Section was attended by 115, half of whom were members of the Section. E. C. Woodward, vice-president of the Texas Section, presided. After individual introductions, Mr. Noyes of the judges announced the awards in the student paper competition and handed a check to each winner. First prize of $25 was awarded to Mr. Crist; second prize of $15 to Mr. West; and third prize of $10 to Mr. Graham. On account of the high quality of the remaining papers in the competition, honorable mention and additional awards of $7.50 each were presented to Messrs. Kuykendall and Sims.

It was announced that inquiry has been made to whether the two Chapters in New Mexico may also meet with the Texas Chapters in these conferences. There were also short addresses by T. U. Taylor, emeritus dean of engineering at the University of Texas; Dean Gibb Gilchrist; and George T. Seabury, Secretary of the Society. Conference officers for the ensuing year were then elected as follows: chairman (to be elected by the Agricultural and Mechanical College of Texas Chapter); vice-chairman, William Hunter, of the University of Texas; and secretary-treasurer, Herbert Gray, of Texas Technological College.

The Conference then adjourned to meet with the Section and hear Dean Taylor's paper on "Ethics," which was based on the principles taught to their children by two carpenters—Joseph, the father of Jesus, and Jefferson, the father of Thomas Jefferson.

At the close of the session, William Hunter, member of the Chapter at the University of Texas, expressed the appreciation of the Chapter members for the opportunity of meeting with the Section.

It was decided that in the future officers for the regional conference would be elected by designated Chapters, the conference business meeting designating which Chapter should elect the chairman, the vice-chairman, and the secretary-treasurer, respectively. The reason for this procedure is the belief that a Chapter can make a more intelligent choice from its entire membership than can the conference group, which might feel itself limited to the students who happened to attend the conference. This plan was initiated by designating the Agricultural and Mechanical College of Texas Chapter as the one to select the chairman of the conference for the coming year. (This Chapter subsequently designated Britton Christian as chairman.)

Data for this report were furnished by John A. Focht, secretary of the Texas Section.

UP-STATE NEW YORK—APRIL 27

Seventy-two representatives and members of Student Chapters in Up-State New York met at Ithaca on April 27, as guests of the Cornell University Student Chapter. As has been the custom for a number of years, this was a joint conference of the Student Chapters and Local Sections in the area. The Student Chapter attendance was as follows: Union College, 5; Clarkson College of Technology, 19; Rensselaer Polytechnic Institute, 4; Syracuse University, 18; and Cornell University, 26.

The Conference opened at 9 a.m. with joint registration followed by inspection of the school of civil engineering at Cornell. The rest of the morning was devoted to parallel meetings of the Local Sections and the Chapters.

George Mueden, president of the host Chapter, welcomed the students and opened the business session. Selections were read from the Conference constitution to acquaint the group with its provisions as to organization and financing. Then one member of each Chapter was called on for an extemporaneous talk on the activities of his Chapter, the principal speakers being George Norris, of Union College; William Graham, of Rensselaer Polytechnic Institute; Richard Vebber, of Syracuse University; Russell Hutchins, of Clarkson College of Technology; and William Gay, of Cornell University. The most pressing problem disclosed was that of overcoming lack of interest among members, and it was suggested that each Chapter make a study to determine the best means of increasing and holding interest among civil engineering students.

DELEGATES ATTENDING UP-STATE NEW YORK CONFERENCE PHOTOGRAPHED AT CORNELL UNIVERSITY

The conference committee had previously announced a contest for papers presented in advance and limited to 1,200 words—the authors to be judged on their ability to collect, organize, and present the material, and on their choice of subject. The judges selected a paper on "Stress Analysis by Model Study of Rainbow Arch Bridge over Niagara River" by E. Hardesty, of Rensselaer Polytechnic Institute, and a copy of Eschbach's *Handbook of Engineering Fundamentals* was awarded to Mr. Hardesty.

At luncheon S. C. Hollister, dean of the college of engineering at Cornell, welcomed the group to the campus and spoke briefly on

the history and formation of the Cornell Engineering School. A surprise was then announced. Through the generosity of Prof. Fred A. Barnes, faculty adviser of the Cornell Chapter, a copy of *Ideals of Engineering Architecture* was awarded to George Norris, of Union College, for the best extemporaneous talk at the morning session.

In the early afternoon the group was conducted on an inspection trip through the U.S. Engineers' Soil Laboratory located on the campus. The inspection was arranged through the courtesy of B. K. Hough, Jr., who is in charge of the laboratory.

At the final business meeting it was decided to accept the invitation of the Rensselaer Polytechnic Chapter to hold the next Conference at Troy in 1941. It was also decided to make the Conference a year-round organization, maintaining correspondence between the Chapters on matters of mutual interest. At the same time the name of the Conference was changed to Up-State New York instead of Northern New York.

Arrangements were in charge of a committee consisting of Howard Eckerlin, chairman; Meier Sofair, secretary; and Howard Simpson, Robert Clarke, John Mattern, and David Milhan. The three local engineering societies—Chi Epsilon, Rod and Bob, and Pyramid—also collaborated. The advisory group included Prof. F. A. Barnes, faculty adviser for the Cornell Chapter; Prof. J. E. Perry, secretary of the Ithaca Section; and Col. H. E. Snyder, contact member for the Cornell Chapter.

This report was signed by the chairman of the Conference commitee, by its secretary, and by the president of the Cornell Chapter.

VIRGINIA—APRIL 27

The Annual Conference of Student Chapters in Virginia was held at Charlottesville on April 27, with the University of Virginia Chapter acting as host. Sixty members were present from the Chapters at the Virginia Military Institute, Virginia Polytechnic Institute, and the University of Virginia.

After Dr. I. F. Lewis, dean of the University, had welcomed the group, four student papers were presented as follows: "Highway Guardrails," by J. S. McCracken, of Virginia Military Institute; "The Restoration of Williamsburg," by W. L. Hilton, of Virginia Polytechnic Institute; "New Railway Truck Development," by F. F. Flowers, of Virginia Military Institute; "Raising the Segovia," by M. M. Fitzhugh, of the University of Virginia. Mr. Fitzhugh was adjudged the winner and awarded the Senior certificate for his paper. This award, consisting of a "certificate of merit," is presented annually by the Virginia Section to the student delivering the best paper at the Virginia Student Chapter Conference.

An innovation on the program was an engineering quiz, conducted on the order of "Information Please" by A. J. Saville, M. Am. Soc. C.E., of Richmond, Va. The quiz group consisted of three students from each of the three Chapters represented. Slips, requiring answers to practical engineering questions, were drawn by the participants, who were given one minute in which to answer. The contest was won by the team representing Virginia Military Institute. This innovation enlivened the meeting and was very favorably received.

The principal address was by Starr Truscott of Langley Field, Va., who spoke on the "History of Civil Engineering." Luncheon followed the adjournment of the meeting. The program concluded with a baseball game between Virginia Military Institute and the University of Virginia.

Data for this report were furnished by Prof. E. W. Saunders, faculty adviser of the Chapter at the University of Virginia.

Mid-Continent Student Chapter Conference Organized

Kansas City Section Host to National Conference

FOR SEVERAL YEARS past, at the Spring and Fall Meetings wherever they may be held, and at the Annual Meeting in New York, the Society has invited the Student Chapters to the technical meetings, inspection trips, and social events, but more particularly to take part in a national Student Chapter Conference. The Kansas City Society Meeting, April 17–19, was no exception.

The University of Kansas Chapter, with the help of the Kansas City Local Section, arranged the details of one of the most successful conferences thus far to be held. Much credit is due them for the perfection with which the details were carried out. The invitation was accepted by delegates from 20 Chapters spread over an area extending from the University of Utah on the west to North Carolina State College on the east, and from the Agricultural and Mechanical College of Texas on the south to the University of North Dakota on the north—150 delegates in all. Accompanying them were 20 faculty advisers and others of the teaching staff. The 25 contact members and other corporate members of the Society who were present brought the total attendance up to nearly two hundred. The University of Kansas Chapter contributed 28 delegates, but based on percentage of Chapter membership in attendance and distance traveled, the South Dakota State College Chapter won the special prize awarded by the Kansas City Section. This prize, a 2-ft silk flag and staff, on a wooden base on which was mounted a bronze plate suitably marked with the Chapter name, was presented publicly at the Thursday evening entertainment.

Student attendance, by Chapters, was as follows:

University of Arkansas	3	Kansas State College	25
University of Colorado	4	University of Kansas	28
University of Illinois	4	University of Minnesota	3
Iowa State College	10	Missouri School of Mines	9
University of Iowa	5	University of Missouri	22

PRESIDENT HOGAN ADDRESSES STUDENT CHAPTER CONFERENCE AT JOINT LUNCHEON

University of Nebraska	2	South Dakota State College	6
North Carolina State College	1	Agricultural and Mechanical College of Texas	12
North Dakota State College	2	University of Utah	1
University of North Dakota	1	Washington University (St. Louis)	4
Oklahoma Agricultural and Mechanical College	4		

The Committee on Student Chapters was represented by Director Charles G. Hyde, contact member, and by John H. Porter, of St. Louis, and Prof. C. L. Eckel, of Boulder, Colo. The responsibility for presiding over the various sessions was divided among four Chapter officers. Each of them acquitted himself in a creditable manner.

The conference opened on Wednesday afternoon with an address by Enoch R. Needles, M. Am. Soc. C.E., on "The Graduate Engineer's Immediate Future," which was followed by an enthusiastic discussion of job-getting, of the value of post-graduate study and of self-appraisal in job selection. Mr. Needles' address in shortened form appears elsewhere in this issue. A second presentation, a fine illustrated lecture on "The Construction of the Pensacola Dam," was given by Victor H. Cochrane, M. Am. Soc. C.E. This interesting project has been described previously in CIVIL ENGINEERING for September and December 1939.

Although the Wednesday evening entertainment and dinner for members of the Society were open to students, the cost induced most of the students to forego the dinner itself, but to accept the invitation of the local committee to attend the dance that followed. A charming group of fifty or sixty girls from Kansas City University assisted in entertaining the members of the Student Chapters. No wonder they had a good time!

Convening again Thursday morning, the conference listened with close attention to Daniel W. Mead, Past-President and Honorary Member of the Society, while he gave a talk on "Ethics for Engineers," based on his paper in the January 1940 issue of PROCEEDINGS, entitled, "Standards of Professional Relations and Conduct." Dr. Mead took advantage of the tardy arrival of some heavy-eyed students to make a sly comment on the value of budgeting one's hours, remarking that one can save five years of his life by being on time. The address was followed by a generous discussion of matters of professional conduct.

MID-CONTINENT CONFERENCE

Explaining the difference between the Society-sponsored "National Conferences of Student Chapters," and the "Regional Conferences of Student Chapters" spontaneously organized and run by the students themselves, Field Secretary Jessup stated that all the Chapters east of the Mississippi were members of some regional conference. He gave a brief picture of their organization, programs, and purposes. Although the Society does not apply pressure for the formation of such conferences, the Committee on Student Chapters recommends that the Chapters give thoughtful consideration to the advantages of participation in them. As a result of the extended discussion which followed on this subject, nine interested Chapters selected two delegates each to confer during the afternoon and perfect plans for the organization of a Mid-Continent Conference of Student Chapters.

Following a luncheon with the members of the Society, which was addressed by President Hogan and by Secretary Seabury, the students joined in various inspection trips to engineering projects in Kansas City. The luncheon and the subsequent trips gave the students a fine opportunity to become better acquainted with members.

The selected delegates, forming themselves into an executive committee, met again in the afternoon, foregoing the inspection trips. They thoroughly debated the proposed formation of a permanent organization in the form of a Mid-Continent Conference of Student Chapters, decided to form such an organization, and adopted a constitution, section by section. They then selected the following officers for the conference: president, C. J. Baer, University of Kansas; vice-president, J. A. York, University of Nebraska; and secretary-treasurer, John C. New, University of Missouri.

The executive committee expressed the desire that the conference should be attended by the whole of each member Chapter rather than be confined to certain delegates, who alone would enjoy the benefits of the meetings. It was also decided that the next meeting be held in Kansas City, and that as far as possible future meetings be held in the same central location. Upon individual ratification of the constitution by each of the nine charter Chapters, the Mid-Continent Conference will attain a permanent existence.

San Francisco Section Assists in Summer Employment for Students

A WORTH-WHILE activity has been started by the San Francisco Section of the Society in helping engineering students in its vicinity to find summer employment in civil engineering work. Not only has the Section recognized the importance of practical experience on the part of the students as a supplement to their engineering education, but it has appreciated the need of constructive assistance to them. So it has taken the initiative in bringing together the students and their prospective employers to the benefit of both.

By means of a circular letter sent out to the members of the Section by President Harold B. Hammill, an effort is being made to discover opportunities. From requests thus obtained, selected students from the three Chapters in the Section's area—that is, University of California, Stanford University, and Santa Clara College—will be given official notes of introduction. The conduct of this work is under a special committee on summer employment, of which H. H. Hall, M. Am. Soc. C.E., is chairman.

This is a valuable service to both employers and students, to be rendered by the Section without cost to either. The selection and hiring is left entirely to the member. Other Local Sections might profit by this idea.

WITH MEMBERS, AT SPRING MEETING OF SOCIETY IN KANSAS CITY ON APRIL 18, 1940

Helping Juniors Through Local Sections

Progress Statement of the Committee on Juniors, as Condensed from Its Report to the Board of Direction, January 1940

By SCOTT B. LILLY, M. AM. SOC. C.E.

CHAIRMAN, SOCIETY'S COMMITTEE ON JUNIORS; CHAIRMAN, DIVISION OF ENGINEERING, SWARTHMORE COLLEGE, SWARTHMORE, PA.

ACTIVE STEPS are being taken by the Society's Committee on Juniors to help these younger members in their professional and economic problems. Progress is being made through the cooperation of Local Sections. Some difficulties were to be expected, but the Committee feels that these can be solved and the entire program advanced, not only to the advantage of the Juniors themselves, but very directly to the great benefit of the entire Society and profession.

At the Chattanooga Meeting of the Society in April 1939, the Committee on Juniors presented a report to the Board of Direction which suggested to the various local Junior committees the following objectives:

A. Work to Be Done with the Juniors

1. To establish as complete a record as possible of the employment, responsibilities, and opportunities for advancement of each Junior in the Section.
2. To encourage the Junior to accept every opportunity for professional advancement whether by graduate study, by preparing papers, by work in the Local Section, or otherwise.
3. To sponsor the formation of Junior branches or forums where the numbers are large enough to indicate that such forums could operate successfully; where the numbers are too small, to encourage the employers of Juniors to organize study groups among them.
4. To see that the suggestion of the Board of Direction—viz., that there be a Junior on each committee of the Local Sections—is carried out; and further, to see that such Juniors report back to the Junior group the action of such committees, so that the Juniors may be familiar with the work of the Sections, and especially so that they may know of the interest of the corporate members in their development and advancement.

B. Work to Be Done with the Employers

1. To take such active steps as may be appropriate under local conditions to encourage all employers of young engineers to give preference to engineering graduates in subprofessional jobs.
2. To make sure that the engineer-employer knows the American Society of Civil Engineers' ratings for such service.
3. To guard against subprofessional rates for work of a truly professional character. (The Committee feels that such low rates endanger the status of the whole profession and that the rates paid by the WPA and by many cities, counties, and states have offended in this regard.)
4. To urge the employer to give the Junior responsible charge of work so far as that may be possible, so that the Junior can qualify for corporate membership and meet the requirements for state registration.

Later the Committee sent a questionnaire to each Section to find out what progress was being made in putting the plan into action. The returns were very gratifying. Reports of 39 of the 47 Sections who returned the questionnaire indicate that the Juniors are active in those Sections, or, if not, that plans are being made to make them active. Nineteen of the Sections have committees on Juniors, all of whom are interested in the proposed program. This is an excellent showing.

The purpose of the Committee now is to extend the work to those Sections where progress has not yet been realized. Difficulties are to be expected in putting any plan into effect, however excellent it may be. The Committee is aware of the problems.

Three steps must be taken in applying suggestions to the Local Sections as above outlined:

1. Creation of the local Committee on Juniors.
2. Determination by the committee of the local needs and feasible objectives.
3. Execution of its program.

All three are equally essential. In a matter of this kind, requiring pioneering effort and much personal sacrifice on the part of the local committee, if its work is to be really effective, the first essential is the right man to act as chairman. Often the member who, by training, experience, and standing in the community, is

PHILADELPHIA SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS
QUESTIONNAIRE FOR JUNIOR MEMBERS

Name ..... Date of birth .....

BIOGRAPHICAL RECORD

Education—Schools Attended ..... Degrees and dates .....

No. of Engagement	Date From	Date To	Title of Position, Name of Employer and Character of Engagement	Total Time	Sub-Prof.	Prof.	Resp. Charge	Design
			Totals					

1. What is your estimate of the opportunities for advancement in your present position? .....
2. If you are not now employed, are you registered with the Technical Service Committee? . Yes..... No.....
3. Would you be interested in the formation of a Junior Forum and would you attend its meetings? . . . . . Yes..... No.....
4. Are there any study groups conducted in your company? . . . . . Yes..... No.....
5. In your company, is preference given to engineering graduates in sub-professional jobs? . Yes..... No.....
6. As far as you know, are the salaries paid in your company commensurate with the Am. Soc. C.E. salary schedules as printed in the Sept. 1939 issue of Civil Engineering? . . . . . Yes..... No.....
7. As far as you can tell now, will you have the necessary qualifications for transfer to Associate Membership in the Society, when you have reached the age for this transfer? . . . . . Yes..... No.....

A PROMPT REPLY WILL BE APPRECIATED—USE THE ENCLOSED REPLY ENVELOPE
USE OTHER SIDE FOR REMARKS

best fitted to act as chairman, refuses to accept the appointment for political reasons. His wage scale and that of his employees have been fixed by a political body and he hesitates to become identified with any movement that could be regarded as controversial. Perhaps he refuses because of the press of work, or because he has retired and is not now in close enough touch with affairs. The real reason for the difficulty found in persuading men to undertake this service is that they realize there is much to be done, that a great change in attitude must be brought about before anything worth while can be accomplished, and they hesitate to attempt the task.

Local needs and feasible objectives vary in the several Sections. In Sections whose membership is small and where the number of Juniors is still smaller, it is possible the activity that would be most profitable to everyone would be to interest young engineers, who are eligible, to become Juniors in the Society. If there are comparatively few Juniors, they can be most helpful in the activities of the Section without any special attention.

However, in larger Sections determination of the program for the aid of the Juniors will require more elaborate study. One method of approach is to send a questionnaire to the Juniors. Herewith is reproduced that sent out by the Philadelphia Section. The number of replies to this particular questionnaire exceeded the expectations of Prof. William H. Chorlton, chairman of the local Junior committee. Other committees may find it possible to adapt this to their needs. It is brought to the attention of the members to help with the problem and with no thought that it should be copied without change.

When the local Junior committee meets to consider the tabulated returns of the questionnaires, it is then ready to formulate a definite program. The committee should not be discouraged if the response of the Juniors is less than 100%. Juniors are passing through a difficult period of adjustment. They have recently graduated from college, many of them have just married, the salary is oftentimes spent before it is received in the effort to get a home started, and it is hard to find the money and the energy for professional development. They should realize that it is a crucial period in their lives, that by making an extra effort at this particular time they may secure earlier advancement and a much richer career.

Execution of the program requires the active interest of the corporate members. It can succeed only if it has the support of the engineer-employer. He is the one who must study the salary scale and see that his men are properly paid and that they are given opportunities for advancement. He it is who must abandon the thought of running a "cheap" job, confusing in his own mind the words "efficient" and "cheap." It is the employer who is in a position to see that his own engineers become members of the Society, and having become members, accept the opportunities which the Society offers them. All that is necessary is for the "chief" to show that he values his membership, that it has proved profitable to him socially and professionally; then the young men will respond. The support of the engineer-employer is also needed in building up in the minds of all concerned the value of the work of the young men. The knowledge that their efforts are appreciated, that the "chief" realizes that they are an asset to his company and to the community, will give the Juniors an added incentive toward further growth and development.

In conclusion we urge the membership to cooperate with the Committee on Juniors in each of the Local Sections. Those unselfish men are faced with real problems. They can succeed only if they receive the aid of the corporate members, who by reason of their age and their position are situated so that they can encourage the young engineer, first, to join the Society as a Junior, and second, to take part in all Junior activities. The engineer-employers will then realize that an enthusiastic hard-working staff bent upon professional development is the best assurance of their own success.

Four Local Sections Have Large Spring Meetings

HIGHLY SUCCESSFUL spring meetings were enjoyed by four Local Sections—Mid-South, North Carolina, Tennessee Valley, and Virginia—in the southern part of the country.

About 160 members and friends of the Mid-South Section met at Little Rock, Ark., on April 29 and 30 for a two-day session of technical discussion and social events. The technical program dealt largely with highway plan and development, the speakers including Frank T. Sheets, president of the Portland Cement Association, whose subject was "The Highway Plan—Determination, Financing, Execution"; R. E. Toms, chief of the division of design of the Public Roads Administration, who spoke on "Geometric Design of the Highway—Alinement, Gradient, Time and Space Perception"; Bernard E. Gray, chief engineer of the Asphalt Institute, who discussed "Cross-Sectional Design of the Highway and Development of the Typical Section"; and Guy Kelcey, sales manager of the Signal Service Corporation, whose subject was "Channelization of Motor Traffic, Intersections, Signal Control." All the papers were enthusiastically discussed.

At the banquet held on the evening of the 29th the Hon. Carl E. Bailey, governor of Arkansas, extended greetings to the group. He was followed on the program by A. M. Harding, director of general extension at the University of Arkansas, who gave a talk on "In-Service Training by Modern Universities." Dancing concluded the evening.

On the morning of the 30th there was a gathering of Juniors, at which the merits of a separate Junior organization were discussed.

Entertainment for the ladies consisted of a luncheon each day, followed by a bridge party one afternoon and a tour of gardens the next.

NORTH CAROLINA SECTION HAS ANNUAL MEETING

Registration for a two-day annual meeting of the North Carolina Section took place at Pinehurst, on April 26. During the technical sessions papers were presented by the following: J. F. Seiler, principal engineer for the Service Bureau of the American Wood Preservers Association, who gave an illustrated lecture on "Treated Wood in Civil Engineering"; E. M. Hastings, chief engineer of the Richmond, Fredericksburg and Potomac Railroad, whose topic was "Railroads and Tomorrow"; Percy W. Foote, rear-admiral, U.S. Navy (retired), who spoke on "How to Prevent Deaths on the Highways"; and F. A. Nikirk, of the Caterpillar Tractor Company, who discussed earth-moving equipment.

Social events included a banquet on Friday night, with President Miller serving as toastmaster. The after-dinner speaker was Howard E. Rondthaler, president of Salem College, Winston-Salem, N.C., who gave an address, "The Mystery of Marshall Ney."

Numerous matters of interest to the Section were brought up at the business sessions. After considerable discussion as to the advisability of establishing the grade of Student Member, the Section went on record as being in favor of the establishment of such a grade. The annual election of officers, also held at this time, resulted as follows: W. C. Riddick, president; H. W. Kueffner, vice-president for one year; A. A. K. Booth, vice-president for two years; and Harold C. Bird, secretary-treasurer.

TWO-DAY SESSION FOR TENNESSEE VALLEY SECTION

The Tennessee Valley Section held its spring meeting at Hiwassee Dam, N.C., on May 3 and 4, with about 260 members and their lady guests in attendance.

Friday afternoon was devoted to the presentation of a series of short papers touching important phases of the Hiwassee Project from its inception through design and construction. The subject was introduced by Theodore B. Parker, chief engineer of the Tennessee Valley Authority. Others participating in the symposium were J. S. Bowman, head planning engineer for the Authority; Harry Hageman, chief design engineer; C. E. Blee, project engineer; O. Laurgaard, construction engineer; J. F. Partridge, assistant construction engineer; J. E. Moreland, principal highway engineer; M. O. Jensen, area engineer; S. M. Woodward, chief water control planning engineer; and D. H. McHenry. [An article on the Hiwassee Dam project—by C. E. Pearce, principal hydraulic engineer—appears elsewhere in this issue.]

After a dinner that evening, Vice-President Erwin Harsch presented as entertainment folk dances by the Campbell Folk School of Brasstown, N.C. This was followed by natural color motion pictures of Haiti, shown by Virgil Kauffman, president of the

Aero Service Corporation. The group then viewed the dam by moonlight.

A symposium on Society affairs was the feature of the Saturday morning session. Those taking part in the discussion were Secretary Seabury, Vice-President Davis, and Director Polk. A paper on "How to Make the Public Conscious of Civil Engineers and the Service They Render Society"—by O. Laurgaard, chairman of the local Professional Objectives Committee—concluded the technical program. A. L. Pauls and C. E. Blee, of the TVA staff, then conducted the members on a tour of the Hiwassee Dam and power house.

The lady guests attended the dinner meeting Friday night and took the trip to the dam on Saturday morning. A special visit to the Campbell Folk School at Brasstown, N.C., noted particularly for its wood carving and collection of folk songs, was also arranged for them.

VIRGINIA SECTION HAS JOINT MEETING WITH OTHER GROUPS

The spring meeting of the Virginia Section—held in Norfolk on April 26 and 27—took the form of a joint session with the Engineers Club of Hampton Roads and local groups of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Architects. The meeting started with business sessions followed by a technical program, consisting of talks by Prof. A. G. Christie and C. M. Davis. The latter discussed "Steam Electric Locomotives," while Professor Christie's subject was "Modern Steam Generators."

At the luncheon the group was welcomed to Norfolk by City Manager C. B. Borland. Then there was a discussion of slum clearance led by W. E. Debnam and Otto Hollowell. The afternoon session, sponsored by the Section, was addressed by T. B. Wright, who spoke on "Wings for Transportation," and Arthur Nutt, whose subject was "Military Engines and Aircraft."

Following a dinner in the evening, Miss Vivien Kellems spoke on "Better Tools for Better Jobs," and Dr. Phillips Thomas, of the Westinghouse Electric and Manufacturing Company, gave a talk on "Rambles in Research."

On Saturday morning the group went to Franklin, Va., to inspect the pulp and paper plant. After a luncheon the meeting adjourned.

Juniors Dominate Membership Trend

CERTAIN RELATIONSHIPS among different parts of the Society membership, particularly the growth of the various grades, are most interesting to follow. One of the best ways is by means of the triaxial chart here given. Basically, such a graph illustrates in percentage the position or changes of three variable components of a whole.

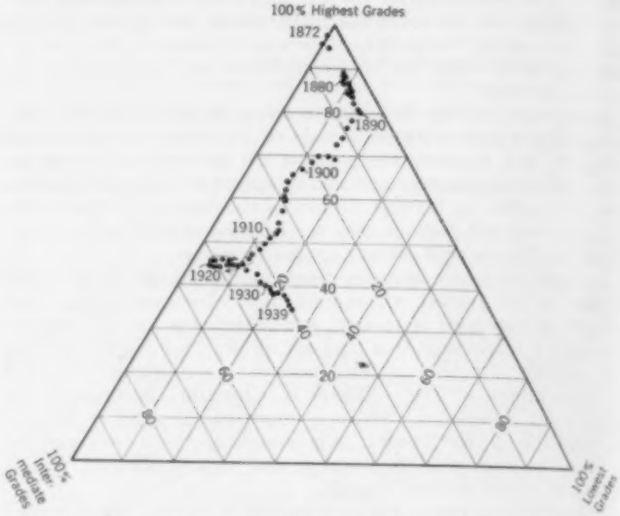
In the present instance the variables are in the percentage of full membership, designated as "highest grade" and increasing vertically; of what is now Associate membership, designated "intermediate grade" and increasing from right to left; and of Junior membership, or "lowest grade" and increasing from the left to the apex at the right. The graph shows nothing as to the total numerical membership. Rather, any point on the chart is a contemporaneous position for each of the three variables, the sum of the three totaling 100%. The point representative of 1939, for example, shows an approximate division of membership as follows:

Members	35%
Associate Members	40%
Juniors	25%
Total	100%

At the beginning—the first data are for 1872—there were only "Members" and "Associates," the latter being considered as corresponding with an intermediate grade. About 1874 the junior grade came into the picture. For a number of years the intermediate grade was negligible and the lowest grade was the most effective factor. As a result, the trend of development up until 1890 was almost directly toward the right apex, corresponding to an increase in the relative number of Juniors in proportion to the other grades.

Beginning soon after 1890, the intermediate grade became the dominating factor. This was because of the establishment of the Associate Member grade in 1891. As a result, for 30 years the relative proportion of members and Juniors remained more or less constant but the number of Associate Members increased markedly. This accounted for the trend of the locus of membership in the chart moving toward the left-hand apex.

Again a variable was introduced, this time with the advent of Student Chapters in 1920 and their growing influence. The result



TRIAXIAL CHART SHOWS SOCIETY MEMBERSHIP TRENDS

was a great increase in the number of Juniors which the Chapters introduced into the Society, while the relative percentages of Members and Associate Members remained quite constant. Thus again, as prior to 1890, the additions to the number of Juniors was the effective factor. This could result only in the motion of the consecutive plottings almost directly toward the right-hand apex, as indicated. A similar graph appeared four years ago in the July 1936 issue.

The ideal distribution of membership might be a matter of individual opinion. It will be observed, however, that the present position is the nearest that the Society membership has ever come to an equal distribution in all three grades.

Perhaps students of statistics or of Society affairs may find other reasons for these trends of growth and make other deductions as to their significance. But there seems to be no question that at the moment the increase in Junior membership is the dominating factor.

Enter "The Tennessee Valley Engineer"

NEWCOMER AMONG the journals for civil engineers is *The Tennessee Valley Engineer*, whose first number was dated April 1940. This is a monthly publication of the Tennessee Valley Section of the Society and is under the direction of a group of Section officers and members. It extends the service previously rendered by *The Lookout Engineer* and *The Bulletin*, the bulletins of the Chattanooga and Knoxville Sub-Sections, which are simultaneously discontinued.

In format *The Tennessee Valley Engineer* is a 6 by 9-in. pamphlet in cardboard covers. It contains notes on the Sub-Sections and Student Chapters, items of personal interest, technical papers, information and news from Society Headquarters, and Local Section business—in other words, it brings the Section and the Society direct to every member belonging to the Section. Over 5 pages of advertising were included in the 24 pages of the first number.

The second number, the May issue, was dedicated to the Section's Spring Meeting at Hiwassee Dam on May 3 and 4 and featured the photographs and professional records of President Hogan, Secretary Seabury, Vice-President Davis, Director Polk, and the local members who participated in the program. A report of the meeting itself appears elsewhere in this issue.

All members will wish success to this, the youngest member in the family of Local Section publications.

Complete Your Record

How COMPLETE is your biographical record on file in the offices of the Society? Should an emergency arise requiring quick mobilization of the collective brain power of this country, would the data now on hand reflect your ability, accomplishments, and capacity as of today, or only up to the year you entered the Society? Several reasons appear, making it desirable for you to bring these records up to date.

Presumably every unemployed member has his complete professional record on file. Last year the Founder Societies' Employment Service placed more than a thousand men. It is in effect an employment service. However, to serve the country as a whole to the best advantage as well as to best serve our members, the professional records of all the employed as well as the unemployed should be readily available when requests are made. Whenever a member already employed is successfully placed in a position more satisfactory to him, the vacancy he has left behind in making the change may be available for a member with no position at all.

Such a Society file made available through the Local Sections in every large city is worth serious consideration. A reasonably complete record at Society headquarters is a start in this direction.

With M-Day long ago provided for by the military arm of the government, the professional engineering talent of the country, the talent badly needed in every conflict, should be accurately listed and classified for use. Would that classification permit you to perform with best efficiency or would it place you wrongly as a round peg in a square hole? Without becoming unduly alarmed should we not have a genuine regard for the necessity of preparedness for peace as well as for war?

Every member who has not filed his record, or whose filed record is not as up to date as he would wish, is invited to make up the deficiency now. Headquarters will send you another blank on request if the old one has been mislaid.

New Concrete Specifications

DESIGNERS almost the world over are well acquainted with the Joint Committee Specifications for Concrete and Reinforced Concrete issued with Society cooperation in 1924. Continuing this work, another Joint Committee was organized in 1930, comprising representatives of the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the American Concrete Institute, the Portland Cement Association and, in 1932, the American Institute of Architects. As a result of ten years of activity, this committee has now submitted a revised set of specifications designed for use in modern engineering practice.

The Society is happy to announce that each member will receive a free copy of these specifications as Part 2 of the forthcoming June issue of PROCEEDINGS. It is also announced that the report will be open to discussion. The pages of PROCEEDINGS will be made available for this purpose in order that members and all others may be advised of the latest constructive thinking on this subject, which is of vital interest to civil engineers.

Appointments of Society Representatives

C. E. MAGNUSSON, M. Am. Soc. C.E., has accepted an appointment to represent the Society at a meeting of the American Association for the Advancement of Science, to be held at Seattle, Wash., from June 17 to 22, 1940.

J. CHARLES RATHBUN, M. Am. Soc. C.E., represented the Society on the occasion of the formal presentation of the memorial plaque of FREDERIC O. X. MCLOUGLIN, M. Am. Soc. C.E., at the College of the City of New York on May 9.

JAMES F. SANBORN, M. Am. Soc. C.E., has been appointed a member of the Committee on the Freeman Fund to fill the vacancy caused by the death of WALTER E. SPEAR.

THORNDIKE SAVILLE, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Engineering Societies Library Board to take the place of J. J. YATES, M. Am. Soc. C.E., who resigned because of the pressure of other duties. Mr. Yates' term would have expired in May 1942.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

NEW BUREAU TO STUDY JOB POSSIBILITIES

FINANCED by an appropriation of $70,000, a new unit to be known as the Occupational Outlook Service is now being set up in the Department of Labor under the direction of Chief Economist A. F. Hinrichs. Its purpose will be to study trends in technological employment, shifts in employment by industries, and changes in opportunities in the professions, with particular attention being devoted to "blind alley" jobs that offer little promise of promotion. For the time being the service will be useful primarily to placement directors and others interested in vocational guidance, but later it is hoped to expand its usefulness by advising individual job-seekers, particularly youths seeking first employment, as to promising fields.

Present plans envision a staff of about 25 persons headed by a director whose selection is imminent.

SUPREME COURT STOPS SALE OF HETCH-HETCHY POWER

Final settlement of a dispute between the federal government and the city of San Francisco dating back to 1923 was rendered when the U.S. Supreme Court on April 22 declared invalid a contract between the city and the Pacific Gas and Electric Company for the distribution of electric power generated as a by-product of the Hetch-Hetchy municipal water development.

In 1913 Congress authorized the city to use lands included in the Yosemite National Park and the Stanislaus National Forest as a source of its water supply on condition that none of the power to be generated as a by-product should be sold to any corporation or individual except a municipality or water or irrigation district. As a temporary measure, the city contracted with the power company to act as its agent in transmitting and distributing the power, and has continued this arrangement ever since.

In 1923, and at intervals thereafter, the federal government has warned the city that this agreement violates the conditions imposed. The federal government applied to the courts for an injunction prohibiting further operation of the power plants. This has now been sustained by the Supreme Court.

The practical effect of the decision is to force San Francisco to choose immediately between setting up a municipal power system or ceasing to operate the Moccasin and Early Intake power plants in the Hetch-Hetchy Valley.

TRANSPORTATION PROBLEM BEFORE CONGRESS

Government planning for future needs and state and local tax relief for the railroads were primary points urged for the relief of the transportation problem in a comprehensive four-volume report recently transmitted to Congress by Joseph B. Eastman, chairman of the Interstate Commerce Commission. Public aid which, in many instances, resulted in little public benefit was assessed in the report with much responsibility for the present surplus of transport facilities. Other factors mentioned are technological changes and unnecessary duplications of facilities. Federal subsidies are listed as follows:

Motor Vehicles—About $31,000,000,000 for highways and streets since the federal-aid program was inaugurated in 1921.

Waterways—$2,971,000,000 for river and harbor improvements and maintenance, flood control, and other stream-improvement purposes to June 30, 1936.

Railroads—$1,443,000,000 through 1935, of which $161,000,000 has been supplied since the World War.

Air Transportation—$64,654,000 in air-mail subsidies; $55,777,000 for airways, airports, and services; $56,500,000 for aids to non-scheduled aviation.

Probable expenditures for transportation facilities, Mr. Eastman estimates, will aggregate $6,000,000,000 by 1950. Continuation of the present system of federal grants will, he warns, perpetuate the conditions of uneconomic competition now perplexing transportation students. In its place, he recommends the creation of a three-man board by the President to investigate the problem of unequities in public contributions and to perform "deliberate and calculated" planning to meet future transportation needs through

the mediums best adapted to serve them. Regulation, he points out, can do much to make such planning effective, or alternately to frustrate attaining its objectives.

On the subject of taxes Mr. Eastman holds that the highway carriers have, since 1927, been paying their own way (a conclusion that is vigorously contested by the railroads) and that railroads are taxed somewhat more heavily than are competing forms of transportation. With minor exceptions federal taxation is not a problem; what is needed is simplification and reduction of state and local taxes. He recommends the repeal of provisions of the land-grant acts that require the railroads to carry mail, troops, and government property at reduced rates on the ground that during the 85 years that these have been effective the initial subsidy granted the railroads has been more than repaid.

That the report bore fruit is indicated by the fact that the President announced the appointment of Owen D. Young, chairman of the General Electric Company, to head a committe to undertake a coordinated study of the nation's transportation problems. A conference committee of Congress which has since January been deadlocked on the Wheeler-Lea Bill to impose uniform federal regulation, through the ICC, on rail, water, and motor carriers, finally reached an agreement on a modified form of the measure which will, if accepted by Congress, effectuate several of Mr. Eastman's recommendations, including the repeal of the land-grant rates. It would also establish still another board of research. Eliminated from the final form were controversial provisions designed to facilitate the merger of railroads.

ACCREDITING PLAN ADOPTED BY ARCHITECTS

With the formation of an agency to be known as the National Architectural Accrediting Board, the profession of architecture, through the American Institute of Architects, the Association of Collegiate Schools of Architecture, and the National Council of Architectural Registration Boards, has formally inaugurated a program for the accrediting of institutions granting degrees in architecture similar to the plan already effectuated by the engineering profession.

COURT UPHOLDS WAGE RULES ON FEDERAL CONTRACTS

In a decision openly critical of judicial interference with administrative procedure, the U.S. Supreme Court on April 29 upheld the action of the Department of Labor in setting minimum wage rates for steel companies desiring to bid upon government contracts.

The case arose from the enforcement of the Walsh-Healey Act, which provides that successful bidders on government contracts amounting to $10,000 or over must pay prevailing wages current in the locality in which the goods are produced. In accordance with its provisions the Department of Labor had ruled that steel companies in the "locality" comprising the 13 northeastern states, the District of Columbia, and part of West Virginia must pay not less than 62½ cents per hour for labor engaged in fulfilling government contracts. This was attacked by a number of steel companies which contended this rate, admittedly prevalent in the Pittsburgh district, should not be extended over so extensive an area. Their contention was upheld by the District of Columbia Court of Appeals, which over a year ago granted an order suspending the ruling.

The Supreme Court, however, ruled that the federal government "enjoys the unrestricted power to produce its own supplies, to determine those with whom it will deal, and to fix the terms and conditions upon which it will make needed purchases." It also criticized the lower court for its "departure into fields hitherto wisely and happily apportioned . . . to the administration of another branch of our government," with the result that in the steel industry "the act has been suspended and inoperative for more than a year." During this period, the Court pointed out, the demands of national defense have made it necessary to award contracts for more than $65,000,000 in iron and steel products without the protection of the declared policy of Congress.

The decision received widespread attention because of its implied criticism of the pending Walter-Logan bill, which provides for the judicial review of administrative actions by governmental agencies.

As a practical matter, it is impossible in the average steel mill to segregate labor engaged upon government work from that for commercial orders. It is therefore necessary for a mill either to apply the government wage scale to all its operations or to forego bidding upon federal contracts.

ENGINEERS PARTICIPATE IN SCIENTIFIC CONGRESS

At the request of Secretary of State Cordell Hull, American Engineering Council, in consultation with its member societies, nominated a number of leading engineers to represent their profession as delegates to the Eighth American Scientific Congress, held May 10–18 in Washington. Educational and scientific organizations in 21 American republics received official invitations to participate in this meeting, which was divided into 11 sections: anthropological sciences; biological sciences; geological sciences; agriculture and conservation; public health and medicine; physical and chemical sciences; statistics; history and geography; international law, public law, and jurisprudence; economics and sociology; education. The following delegates represented the societies named:

American Engineering Council—Alonzo J. Hammond, William L. Batt, C. O. Bickelhaupt, John S. Dodds, Col. Donald H. Sawyer, Leonard J. Fletcher, F. Malcolm Farmer, Alvan L. Davis, Warner Seely, Edwin F. Wendt, Eugene W. O'Brien, James R. Withrow, Andrey A. Potter, George W. Burpee, Dugald C. Jackson, Dr. William McClellan, J. F. Coleman, Frederick M. Feiker.

American Society of Civil Engineers—John P. Hogan, Henry E. Riggs, Donald H. Sawyer, Alonzo J. Hammond, John F. Coleman, Arthur S. Tuttle, George T. Seabury, James L. Ferebee, George C. Lucas, Glenn L. Parker, John C. Page, General Julian L. Schley, General Thomas M. Robins, Admiral Ben Moreell, Elmer W. Clark, Lawrence M. Lawson, Ralph Budd, Walter J. Douglas, Randall Cremer, Enoch R. Needles, George W. Burpee, Fred Lavis, Dr. Francisco Jose Sucre.

American Institute of Consulting Engineers—Admiral R. E. Bakenhus, J. E. Greiner, Major J. P. Hallihan, Fred Lavis, Henry G. Perring, William B. Poland, H. M. Waite, Ezra B. Whitman.

U.S. TRYING TO DEFINE PROFESSIONAL STATUS

Redefinition of the executive, administrative, and professional groups legally exempted from provisions of the Fair Labor Standards Act is currently being studied by the Wage-Hours Administration of the Department of Labor. The question arose as an incident to hearings on the wholesale distributive industries, which has a number of technical employees, but is of interest to professional groups because any definition arrived at would probably be extended to other industries. Considerable testimony suggesting various definitions, broad and narrow, was presented, but a final determination has not yet been announced.

Washington, D.C.
May 6, 1940

News of Local Sections

Scheduled Meetings

COLORADO SECTION—Dinner meeting at the University Club on June 10, at 6:30 p.m.

INDIANA SECTION—Dinner meeting at the Washington Hotel, Indianapolis, on June 7, at 6:15 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on June 12, at 6 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on June 6, at 7 p.m.

PHILADELPHIA SECTION—Outing and dinner meeting at the Sandy Run Country Club on June 11 (golf and other sports in the afternoon; dinner at 6 p.m.).

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

SAN FRANCISCO SECTION—Regular bimonthly dinner meeting at the Engineers' Club of San Francisco on June 18, at 5:30 p.m.

Recent Activities

ARIZONA SECTION—*Tucson, April 5 and 6:* On these dates members of the Arizona Section attended the Third Annual Roads and Streets Conference, of which the Section was joint sponsor with the civil engineering department of the University of Arizona and the Arizona State Highway Department. The list of members

represented on the technical program included G. L. McLane, senior highway engineer for the Public Roads Administration at Phoenix; W. R. Hutchins, state highway engineer; Hugh Barnes, regional highway engineer for the Portland Cement Association at Los Angeles; James Girand, city engineer of Phoenix; Walter Johannessen, traveling engineer inspector for the PWA; P. J. Glendening, resident engineer for the Arizona State Highway Department at Safford; and E. V. Miller, traffic engineer for the State Highway Department. The president of the Section, Vic. H. Housholder, presided at a joint dinner meeting of the Section and the University of Arizona Student Chapter, which took place on the evening of the 5th.

CENTRAL ILLINOIS SECTION—*Champaign, February 21 and April 11:* At the first of these two dinner meetings the speakers were W. W. DeBerard and Walter E. Jessup, Director and Field Secretary of the Society, respectively. Both discussed different phases of Society affairs. The April meeting was devoted to entertaining the ladies of the Section. Group singing was enjoyed, and W. H. Voskuil, mineral economist for the State Geological Survey, spoke on the subject, "The European Conflict as Affected by Mineral Distribution and Control."

CENTRAL OHIO SECTION—*Columbus, March 21 and April 18:* The speakers at these regular monthly luncheon meetings were A. Ray Olpin, director of industrial research and field director of the Engineering Experiment Station at Ohio State University, and Don W. Wiper, secretary of the Ohio State Industrial Commission. Dr. Olpin's subject was "Present Trends in Industrial Research," while Mr. Wiper discussed municipal taxation.

CINCINNATI SECTION—*April 9:* An illustrated talk on "Applications of Polarized Light as a Civil Engineering Tool" was the feature of the occasion, the speaker being Robert C. Gowdy, dean of the college of engineering and commerce at the University of Cincinnati.

COLORADO SECTION—*Denver, April 8:* Two members of the Section—George M. Bull and John E. Field—who have been away from the Section for some time, expressed their pleasure at being home again and briefly described the work they have been doing in other parts of the country. The principal speaker of the evening was then introduced. This was Albert W. Recht, director of the Chamberlain Observatory of the University of Denver, whose subject was "The Expanding Universe." *Junior Association, February 26 and March 25:* At the first of these sessions the speakers were Clyde E. Learned and J. W. Courter, of the staff of the Public Roads Administration. The former spoke on mountain road construction problems, while Mr. Courter showed colored slides of bridge construction in Yellowstone Park. The guest speaker at the March meeting was E. B. Gittings, principal meteorologist for the U.S. Weather Bureau, who discussed the work of the Bureau with special reference to the new radio weather-data reporting machines.

CONNECTICUT SECTION—*New Haven, April 30:* The seniors in civil engineering at Yale University were guests of the Section at its annual meeting. During the business meeting W. A. D. Wurts was elected president for the coming year, and Arthur W. Bushell, vice-president. Joseph P. Wadhams was reelected secretary-treasurer. The technical program consisted of a talk on "Opportunities for Engineers in Industry," which was given by Charles E. Smith, vice-president of the New York, New Haven and Hartford Railroad.

DAYTON SECTION—*April 29:* An inspection tour of the recently constructed garbage incinerator plant, followed by a dinner and technical program, attracted the largest attendance in many months. The list of outside guests included the city manager, mayor, and members of the city commission. Harrison P. Eddy, Jr., who represented the consulting engineers on the incinerator plant project, was the principal speaker. Mr. Eddy illustrated his talk with slides covering features of design.

DISTRICT OF COLUMBIA SECTION—"Engineering in the National Parks" was the subject of a lecture presented by Edmund F. Preece, senior engineer in the National Park Service. Mr. Preece illustrated his talk with Kodachrome slides.

DULUTH SECTION—*February 19 and March 18:* The first of these sessions was devoted largely to business discussion. S. B. Shepard spoke briefly on the new rules for registration of engineers in Minnesota being proposed by the Minnesota State Board of Registration and the new classification of engineers and their salaries being studied by the Minnesota Civil Service. The principal speaker at the March meeting was C. L. Kohlhaas, of the Gardner Denver Company, who described the details of the work of drilling and driving the two-mile tunnel for the Duluth sewage disposal system.

FLORIDA SECTION—*Hollywood Beach, April 11:* Following a luncheon President Reynolds reviewed some of the Section activities during the past year and discussed plans for the future. Other speakers then heard were Leroy S. Edwards and Milton B. Garris, officers of the Miami Section, who were guests of the Florida Section. The latter discussed the Society's proposed salary schedule. The meeting adjourned at 2:15 p.m. and convened again at 4:30 for a business discussion, the purpose of the recess being to allow members to attend sessions of the Florida Engineering Society held concurrently with the Section meeting. *Gainesville, May 3:* On this occasion a joint meeting of the Section and the Student Chapter at the University of Florida took the form of a dinner in honor of Prof. Percy L. Reed, who has just completed twenty years of service at the University. Charles Lassiter, president of the Student Chapter, acted as toastmaster, and the list of speakers included Alfred F. Harley, life member of the Society. During the meeting it was announced that the recipient of the Section's award of Junior membership in the Society to the outstanding civil engineering graduate of the University of Florida is Berney B. Cowden.

INDIANA SECTION—*Lafayette, May 2:* Joint meeting with the Purdue University Student Chapter. The principal speaker was Robert B. Brooks, Director of the Society and consulting engineer of St. Louis, Mo., who addressed part of his talk to the young engineering graduates and, also, spoke on matters of general interest to the profession. Brief talks by Professors R. B. Wiley and B. H. Petty concluded the program.

KANSAS STATE SECTION—*Topeka, April 26:* Following dinner R. J. Paulette, consulting engineer of Topeka, Kans., spoke on the subject of Rural Electrification Administration development in Kansas.

LOS ANGELES SECTION—*April 10:* A symposium on concrete was the feature of the occasion, the list of speakers including W. L. Chadwick, civil engineer for the Southern California Edison Company, and R. R. Coghlan, assistant chemical engineer for the California Portland Cement Association. The talks were followed by a motion picture entitled "From Mountain to Cement Sack," which was presented by Arthur D. Brown, district manager for the Allis Chalmer Manufacturing Company.

LOUISIANA SECTION—*New Orleans, March 25 and April 29:* The speaker at the first of these meetings was George P. Rice, consulting engineer of New Orleans, who discussed the foundation settlement of the newly constructed Charity Hospital and methods of overcoming it. The April meeting was addressed by John P. Hogan, President of the Society, and George T. Seabury, Secretary. On April 25 the members were guests of the Louisiana Post of the Society of American Military Engineers to hear Lt. Col. R. G. Moses give an illustrated talk on "Construction of Sardis Dam."

MARYLAND SECTION—*Baltimore, April 16:* An illustrated lecture on "The Military Engineer in Modern Warfare" was the feature of the evening, the speaker being Stuart C. Godfrey, colonel, Corps of Engineers, U.S. Army.

METROPOLITAN SECTION—*April 17:* Ole Singstad, chief engineer for the New York City Tunnel Authority, presented a paper on the Queens-Midtown Tunnel, illustrating his remarks with numerous lantern slides. The paper elicited considerable discussion.

MICHIGAN SECTION—*Detroit, April 19:* Following a dinner, Walter C. Sadler, mayor of Ann Arbor and associate professor of civil engineering at the University of Michigan, spoke on engineering law.

MOHAWK-HUDSON SECTION—*Albany, N.Y., April 18:* The speaker of the evening was S. C. Hollister, dean of the college of engineering at Cornell University, who gave an illustrated lecture on "The History of Engineering Science." Dean Hollister traced the development of basic principles used in engineering from the early use of the lever, inclined plane, screw, and wedge to our present-day accomplishment. Later he displayed a valuable collection of early engineering books.

NEW MEXICO SECTION—*Albuquerque, April 29:* Joint meeting with the University of New Mexico Student Chapter. The technical program consisted of a talk by W. D. Collins, chemist in charge of the Quality of Water Division, U.S. Geological Survey, who spoke on the effect of the quality of water on engineering and industrial problems.

NORTHEASTERN SECTION—*Boston, April 17:* Joint meeting with the Boston Society of Civil Engineers. The speaker of the evening was Miles N. Clair, vice-president, director, and treasurer of the Thompson and Lichtner Company, of Boston, who spoke on "Concrete Technology." *Worcester, Mass., April 26:* Joint meeting with the New England Student Chapter Conference. During the evening prizes were awarded to the five best papers read at the Conference in the evening. First prize went to J. Bruce Espy, of Dartmouth College; second to Walter B. Kelley, of Northeastern University; and third to Richard A. Coleman, of Worcester Polytechnic Institute, and Richard J. Eberle, of Massachusetts Institute of Technology. A demonstration of the "Use and Abuse of Gasoline and Kerosene" was given by Charles M. Allen, professor of hydraulic engineering at Worcester Polytechnic Institute. *Junior Association, April 30:* Talks were given by John B. Scalzi, whose subject was "Model Studies of Continuous Girder Bridges," and Robert W. Vose, who discussed "Dynamic Investigations of Materials under Stress." Both young men are members of the Association.

NORTHWESTERN SECTION—*Minneapolis, Minn., May 6:* A symposium on professional objectives was the feature of the occasion, the speakers being George E. Loughland, Harry Mickelson, Hibbert M. Hill, and Frederic Bass. A paper by Bernard Blum, bridge engineer of the Northern Pacific Railway, was read by the secretary, and L. G. Straub gave a report on the Kansas City Meeting. During the evening it was announced that the Section's prizes for 1940 go to the following students: Maurice Woxland, Herbert Gaustad, and Charles Archibald, of the University of Minnesota; E. B. Stevenson, of the University of North Dakota; James McMahon, of the North Dakota State Agricultural College; and James Norman, of the South Dakota State School of Mines.

OKLAHOMA SECTION—*Norman, April 3:* Joint meeting with the Student Chapters at the Oklahoma Agricultural and Mechanical College and the University of Oklahoma, the latter Chapter acting as host. Eldon Rogers, president of the University of Oklahoma Chapter, was chairman of the meeting, and Prof. N. E. Wolfard gave the address of welcome. The technical program consisted of talks by R. E. Kirkham, professor of structural engineering at the Oklahoma Agricultural and Mechanical College, and William T. Burtschi, head of the U.S. Soil Conservation Service office at Elk City, Okla. An unusually mystifying sleight-of-hand performance, shown by Bill Weldon, a member of the host Chapter, provided lighter entertainment, and the announcement of the Section's prizes of Junior membership in the Society concluded the evening. The recipients were Eldon Rogers, of the University of Oklahoma Chapter, and William Hall and George Asplund, of the guest Chapter.

OREGON SECTION—*Portland, May 3:* The feature of the occasion was a symposium on the Front Avenue Widening Project. Those participating were Ben Morrow, John Beakey, F. T. Fowler, E. A. Collier, and G. S. Paxson. C. B. McCullough, assistant state highway engineer, was in charge of the program.

PHILADELPHIA SECTION—*April 11:* The Section and the Engineers Club of Trenton arranged an inspection trip to the Turnstedt Trenton Plant of the General Motors Company. Dinner and a technical program followed the inspection, the speaker being Roger W. Armstrong, deputy chief engineer of the New York City Board of Water Supply. Mr. Armstrong gave an illustrated lecture on the important design and construction features of the Delaware River supply project, and a general discussion followed.

PROVIDENCE SECTION—*March 27:* Members of the Section made an inspection tour through the new police and fire station in Providence. George J. Geisser, chief engineer of the Providence Department of Public Buildings, acted as guide. *April 10:* Prof. Hardy Cross, of Yale University, was entertained by the Section at a dinner. Later in the evening Professor Cross addressed a large group of members and their guests on the subject, "Continuity in Structures—What of It?"

SACRAMENTO SECTION—*April 2, 9, 16, 23, and 30:* The speakers at the first four of these luncheon meetings were H. L. Hume, member of the New Zealand Institute of Engineers, who is visiting this country as a Commonwealth Fund Service Fellow; Charles G. Hyde, Director of the Society; W. L. Cozzens, of the Fairchild Aerial Surveys; and Edwin C. Kelton, district engineer for the Southern California District of the U.S. Engineer Office. April 30 was the occasion of the Annual Junior Day sponsored by the Section. The officers of the Junior Forum conducted the meeting and presented a debate on the subject, "Resolved that the Government Should Finance and Construct Low-Cost Housing for the Low-Income Groups." The affirmative was upheld by E. F. Sullivan and Vernon Hansen, the negative by William Popper and Glenn Chamberlain.

ST. LOUIS SECTION—*April 22:* At noon there was a joint luncheon with the Construction Industries Committee of the St. Louis Chamber of Commerce, with local groups of the Society of American Military Engineers and the Illinois Society of Engineers. The speakers were A. P. Greensfelder, president of the Fruin-Colnon Contracting Company; John P. Hogan, President of the Society; and George T. Seabury, Secretary. A special dinner meeting took place in the evening to permit the members to discuss Society affairs with President Hogan and Secretary Seabury. Other Society officers present were Directors Harrington, Parker, and Brooks.

SAN FRANCISCO SECTION—*April 16:* A talk on "Recent Parkway and Highway Developments in the Eastern United States" was given by Ronald L. Campbell, planning engineer-secretary to the San Mateo Planning Commission. George Posthumus, of the University of California, was awarded Junior membership in the Society. *Junior Forum, March 26:* The technical program consisted of a symposium on "jobs," the speakers being three members of the Forum—W. C. Hamilton, A. J. Macchi, and L. H. Oppenheim. The subject for open discussion was "Preparation for the State of California Civil Engineers' Registration Examination."

SPOKANE SECTION—*Moscow, Idaho, March 21:* Joint meeting with the Student Chapters at the University of Idaho and Washington State College. A talk on the organization of highway departments was given by H. R. Flint, director of highways for the state of Idaho. *April 12:* F. E. Thieme, assistant regional forester for the U.S. Forest Service, presented an illustrated lecture on the work of the forestry department and showed some slides on aerial mapping.

SYRACUSE SECTION—*May 4:* Secretary Seabury and Director Harrington were the guests of honor on this occasion. Both discussed different phases of Society activities, and there was an open forum on the subject of how to make the public conscious of the civil engineer's service to society. Those taking part in the forum were E. F. Berry (chairman), Earl F. O'Brien, Fred S. Glynn, Jr., Kendall E. Doman, and Cecil S. Camp. During the annual election of officers W. H. Kavanaugh was selected as president, and M. J. French as vice-president. J. W. Ackerman will continue as vice-president for another year, and Cecil S. Camp as secretary-treasurer.

TACOMA SECTION—*April 9:* Following a dinner Joseph Jacobs, Vice-President of the Society, gave a report on the Annual Meeting in New York, and President Thomas reviewed recent Section activities. The principal speaker of the evening was F. B. Farquharson, associate professor of civil engineering at the University of Washington, who discussed latest developments in the field of photoelasticity.

TENNESSEE VALLEY SECTION—*Chattanooga Sub-Section, April 9:* Juniors, under the chairmanship of James Pou, were in charge of the program, and five-minute talks by a number of Juniors were the feature of the occasion. The speakers were John Hayeson, Stanley Biesack, A. S. Hamm, Joe Hocker, E. F. Newman, and Frank Bosland. Subjects ranged from "Why I Became a Member of the Society" to "Economic Surveys for Highways." *Knoxville Sub-Section, April 9:* An illustrated talk on "Old Mexico" was the feature of the occasion. Several musical selections were also enjoyed.

TOLEDO SECTION—*April 12:* The speaker of the evening was Edward Young, assistant professor of geodesy and surveying at the University of Michigan. Professor Young discussed the subject, "Photographic Exposure as the Engineer Would Analyze It," demonstrating by drawings methods of determining correct expo-

sure by plotting curves of the sun's altitude and declination. The showing of two reels of motion pictures of the West concluded the program.

TRI-CITY SECTION—*Moline, Ill., April 15:* Joint meeting with local groups of the Society of American Military Engineers, the Illinois Society of Engineers, and the Reserve Officers Association. A talk on "The Importance of Maps in National Defense" was given by Maj. William Bowie, retired hydrographic and geodetic engineer for the U.S. Coast and Geodetic Survey.

WYOMING SECTION—*Laramie, April 25:* Annual joint meeting with the Student Chapter at the University of Wyoming, with Harold Zoller, member of the Chapter, acting as toastmaster. Mark Henderson, also a member of the Chapter, presented a paper on rural electrification, and Mr. Henderson and David Hays were announced as winners of the Section's awards of Junior membership in the Society. A talk on "The Future of Wyoming," by A. G. Crane, president of the University of Wyoming, concluded the program. The meeting then adjourned to the engineering building, where the group were guests of the college of engineering at the annual "open house."

Student Chapter Notes

BROOKLYN POLYTECHNIC INSTITUTE—*April 25:* James Reid Parker, member of the staff at the Institute and book reviewer for a New York publication, spoke on "Recreational Reading for the Engineer."

BROWN UNIVERSITY—*March 11:* N. L. Hibbert, student speaker for the occasion, presented a short talk on modern methods of navigation. At the April meeting the contact member, Harold Miller, gave a short talk, and Robert S. Wilmot, a member of the Chapter, spoke on the subject of "Flood Control on the Connecticut and Winooski Rivers." Election of officers for the coming school year resulted as follows: William F. Allen, president; Norman L. Hibbert, vice-president; Robert S. Wilmot, secretary; and Andrew Clarke, treasurer.

COLLEGE OF THE CITY OF NEW YORK—*April 5, 11, and 25, and May 2:* On the first of these dates members of the Chapter visited the Delaware Water Supply Project, the trip including stops at the Kensico Reservoir, the Mt. Kisco sewage treatment plant, and several of the shafts under construction. The other two meetings in April were devoted to talks—by C. A. Reed, assistant engineer for the New York City Board of Transportation, and William Armento, Junior contact member. At the May meeting a motion picture on the "Uses of Asphalt" was shown through the courtesy of the Asphalt Institute.

COOPER UNION—*March 25:* A discussion of railroad reorganization from the viewpoint of the railroads was presented by Lawrence Furnald, assistant secretary and treasurer of the Chicago and Northwestern Railroad.

LOUISIANA STATE UNIVERSITY—*March 17:* Members of the Chapter visited the Mississippi River bridge at Baton Rouge, the purpose of the trip being to watch the closing of the upper and lower chords of the bridge. *April 19:* An illustrated talk on the Galveston Causeway and the construction of the Neches River (Texas) Highway Bridge was given by George G. Wickline, bridge engineer for the Texas State Highway Department. A paper on "Malaria and Yellow Fever Control in the Tropics," by J. A. LePrince, concluded the program.

NEW YORK UNIVERSITY—*April 4 and May 1:* Members of the evening division of the Chapter heard talks by F. C. Young, a member of the Chapter, and Vincent R. Cartelli, Junior contact member. Officers for next year will be Fergus O'Connell, president; F. C. Young, vice-president; T. Kelly, secretary; and T. Lane, treasurer.

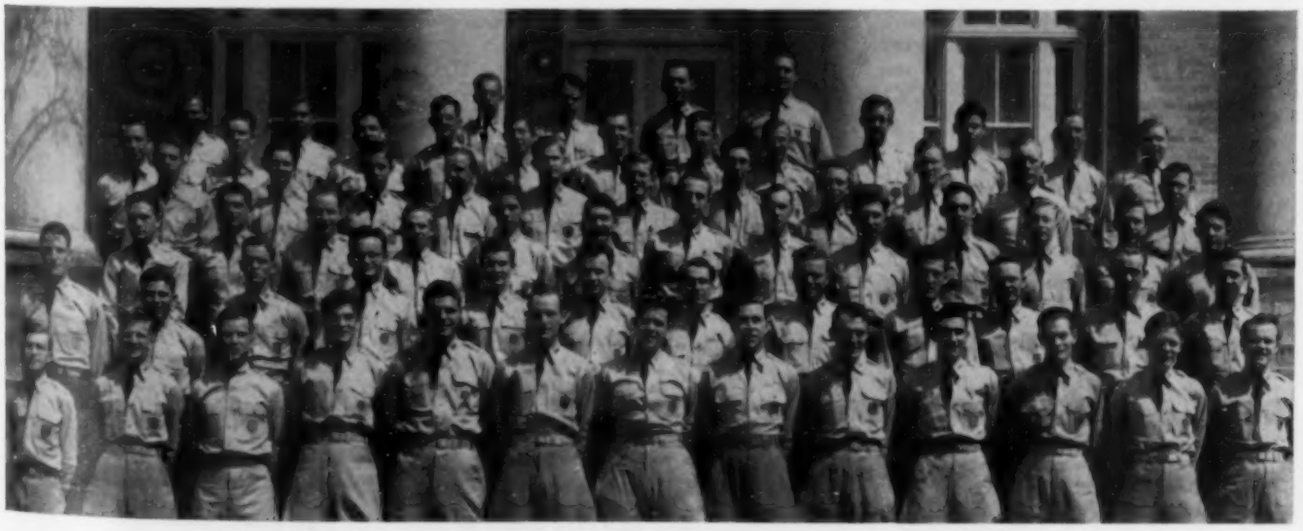
NEWARK COLLEGE OF ENGINEERING—*May 9:* The feature of the occasion was the showing of a motion picture of work undertaken by some of the students at the Massachusetts Institute of Technology summer surveying camp.

RUTGERS UNIVERSITY—*March 12:* An illustrated lecture on the construction of the Edison Bridge at Perth Amboy, N.J., was given by Morris Goodkind, bridge engineer for the New Jersey State Highway Department.

UNIVERSITY OF UTAH—*April 10:* The following officers were elected for the coming school year: Jerald Wadsworth, president; David Curtis, vice-president; Robert Childs, secretary; and Orsen Flatburg, treasurer. The Chapter announced that its most important accomplishment this quarter was the winning of first prize for the best exhibit shown during Engineers Week. As a matter of fact, the Chapter has taken first place in every activity of the engineering school this year.

TULANE UNIVERSITY—*April 18, 25, and 29:* At the first of these sessions J. A. LePrince spoke on "Malaria and Yellow Fever Control in the Tropics," illustrating his talk with lantern slides. On the 25th the members visited the New Orleans plant of the Jones-Laughlin Steel Company. President Hogan and Secretary Seabury were guests of the Chapter at the last of these sessions, and both spoke.

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS: The Chapter reports that it has enjoyed an unusually active year and a considerable increase in membership. For the first time since the World War it sponsored a "prom," which proved highly successful. On March 29 Edward S. Bres, Director of the Society, addressed the Chapter on the relationship of the Society to the engineering profession. On April 16 four papers were presented in a prize contest, the speakers being J. W. Whitson, C. S. Hinshaw, J. D. Hancock, and Jack West. First prize went to Mr. West for his paper on "Surveying in Texas."



MEMBERS OF STUDENT CHAPTER AT AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for July

AMONG THE material scheduled for inclusion in the July issue will be a symposium of six valuable papers dealing with available methods for the conditioning of structural steel surfaces for painting as protection against corrosion. These papers, originally presented at the Society's Spring Meeting, before the Structural Division, will give the results of much study and research on this problem—the causes of corrosion, characterized as construction's "common cold," and its amelioration.

Another paper describes the Bayonne Terminal in New York harbor, which provides ship-to-rail facilities for the transshipment of exports and imports as well as auxiliary ship-side storage. It has been in operation somewhat more than a year. The design and construction of this $4,000,000 project is described by Marcel Garsaud, M. Am. Soc. C.E., in the last of the series of papers on the Port of New York originally presented at the Annual Meeting in January.

Kansas City, Mo., has an outstanding civic asset—its recently completed municipal auditorium—a 6½ million dollar structure with a number of unusual problems of design and erection occasioned by its sheer massiveness. In all, 25,000 people can attend four different functions without interfering with one another. How the job was designed and constructed is to be told by S. J. Callahan, Assoc. M. Am. Soc. C.E.

A number of possibilities for the July issue depend upon the space available. One possibility is an interesting description of the raising and widening of a concrete T-beam bridge, occasioned by the flooding of the Chickamauga Reservoir. Further articles on the Pennsylvania Turnpike, on Hiwassee Dam, and on problems of pollution abatement in the New York area are also planned for inclusion, as well as abstracts of a number of other papers delivered before the Kansas City Spring Meeting.

Page of Special Interest Shows Coast Bridge

ON THE Page of Special Interest in this issue is shown one of the piers of the Coos Bay Bridge in the state of Oregon. This is one of five bridges constructed by this state on the Coast Highway, by means of which Oregon has provided an uninterrupted route along the coast from the Columbia River to the California state line. They were completed in December 1936 at a project cost of $5,435,351.

All five structures are of considerable magnitude. Care in designing and planning, with an eye to beauty, is apparent in the treatment of the Coos Bay Bridge pier on the Page of Special Interest.

Early Pile Drivers—Hand vs. Steam

By R. D. CHELLIS, M. AM. SOC. C.E.

ENGINEER, STRUCTURAL DIVISION, STONE AND WEBSTER ENGINEERING CORPORATION, BOSTON, MASS.

IN THE DAYS before steam pile hammers were invented, many ingenious pieces of equipment were employed to drive piles and a great number of piles were laboriously driven with them. Two of the most interesting of such were Bunce's and Valoue's machines, reproduced here from an old engraving which appeared in the rather scarce *Cyclopaedia Londinensis, or Universal Dictionary of Arts, Sciences and Literature*, published in London and printed for the proprietor by J. Adlard. This engraving bears the date 1816, and the pile drivers shown were therefore in use prior to that time.

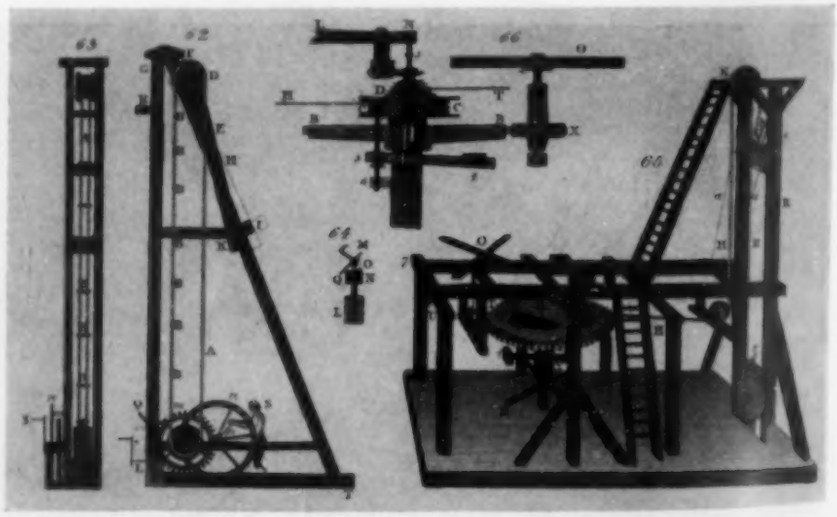
These machines were drop hammers, employing complicated arrangements of gearing to obtain the force required to lift the hammer after each blow. Four men were frequently used to raise the hammer. Since many of the piles driven were quite long, short drops would be used to start the pile down through the upper strata, the fall becoming greater as more energy was needed to drive it into the harder strata below.

The question of the proper height of fall caused considerable discussion, as the following quotation from an old article in the *Encyclopaedia Metropolitana*, published in 1845, shows:

"The subject, some years ago, engaged the attention of several able scientific men. It is obvious that the higher the weight is lifted the longer time will be employed, not only in the operation of lifting, but also in time of falling; but the blow will be greater also, and that in a higher ratio than the time; because the velocity is as the square root of the height, whereas the time is as the height merely; hence arose a question of maxima and minima which led to great controversy, some making it appear that the effect would be greater, the greater the greater height, and others that it would be greater as the height was less. The parties engaged in this controversy were of some considerable scientific eminence, and it was rather to show the fallacy of depending wholly on theory in practical cases than for any other purpose that we give the following remarks on this controversy, from the fourth volume of *The Collection of the Mathematical Papers from the Ladies Diary*. . . ."

Similar hand-operated equipment was used until the invention of the steam pile hammer by James Nasmyth and its first use in 1845 at the Devonport Dock for the Royal Navy. The historic scene when it was first used, in competition with the old type, is interestingly described in Smiles' *Life of James Nasmyth:*

"There was a great deal of curiosity in the dockyard as to the action of the new machine. The pile-driving machinemen gave me a good-natured challenge to vie with them in driving down a pile. They adopted the old method, while I adopted the new one. The resident managers sought out two great pile logs of equal size and length—70 feet long and 18 inches square. At a given signal we started together. I let in the steam, and the hammer at once began to work. The four-ton block showered down blows at the rate of eighty a minute; and in the course of four and a half minutes my pile was driven down to the required depth. The men working at the ordinary machine had



TWO OLD PILE DRIVERS—FROM THE *Cyclopaedia Londinensis*
At Left "Bunce's Pile Engine," and at Right, "Valoue's Pile Engine"

only begun to drive. It took them upwards of twelve hours to complete the driving of their pile! Such a saving of time in the performance of similar work—by steam versus manual labour—had never before been witnessed. The energetic action of the steam hammer, sitting on the shoulders of the pile high up aloft, and following it suddenly down, the rapidly hammered blows keeping time with the flashing out of the waste steam at the end of each stroke, was indeed a remarkable sight. . . . At this the spectators, crowding about in boats, pronounced their approval in the usual British style of 'three cheers!' "

Thus sounded the death knell of Bunce's and Valoue's machines and their ilk.

Government Restrains Correspondence School

THE FOLLOWING is taken from an official release of the Federal Trade Commission in Washington for May 3, 1940:

McKinley-Roosevelt College of Arts and Sciences, Chicago correspondence school, has been ordered by the Federal Trade Commission to cease and desist from certain unfair competitive methods and deceptive practices in thes ale of home-study instruction courses. The respondent, according to findings, advertised in magazines and periodicals circulated in various states that it offered home-study courses of instruction leading to degrees in arts, sciences, philosophy, education, and a large number of other branches of learning at low cost and on easy terms.

One type of advertisement was headed: "Earn a Degree at Home. Home Study Courses Leading to Degrees in Arts, Sciences. . . ." Catalogs also were distributed having on the cover the title "McKinley-Roosevelt College of Arts and Sciences. College of Engineering Annual Catalogue." Findings are that the school lacks all requirements with respect to equipment and educational facilities which would entitle it to be classified as a college or university, and that degrees conferred by the respondent are not recognized by accredited institutions of higher learning. The Commission order directs the respondent McKinley-Roosevelt College of Arts and Sciences to cease and desist from using the words "College" or "University" in its corporate or trade name, and from representing that its business is that of a university, college, or institution of higher learning.

The respondent also is directed to desist from representing, through use of symbols indicating academic degrees or by any other means, that members of its faculty are educators duly qualified by higher education, when the degrees so indicated are not the result of study pursued in residence at recognized colleges or universities duly authorized to grant the respective degrees indicated, or when the symbols used do not represent degrees actually granted by such institutions to the respondent's faculty members, or when the persons receiving such degrees are not teachers, educators, or persons of high educational attainment.

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

REMINDING Prof. N. G. Neare at the next regular meeting of the Engineers Club that his answer to Explorer Nipp's question was somewhat indefinite, he stepped up to the blackboard with a vain attempt to appear reluctant. "Really I was very definite. If Nipp had followed his plan to cruise from the equator to the Northeast Pole at the rate of 2,500 miles per day and then wait for Tuck, who was cruising under the same plan to the Northwest Pole, he would have waited one or two eternities, according to his fancy on eternities. Did anyone try to check my statement?"

"I tried it graphically," said one. "It was simple for the first two days, on each of which he crossed two time meridians, and for the third day on which he crossed four more. But on the fourth day he was crossing meridians so fast and winding around the pole so tight that it made me dizzy. I knew I was dizzy when I tried to figure how fast he would have to go from one time meridian to the next, and infinite velocity wasn't fast enough."

"Even then you were on the right track," said the Professor. "Infinite velocity wasn't fast enough. Only if time could run backwards could the plan be completed.

"Suppose we let

t = time in days observed by the explorers
T = time in days elapsed at Greenwich
ϕ = longitude eastward from Greenwich

Then

$$T = t - \frac{\phi}{360}$$

"This equation assumes that the explorers kept their time corrected—not waiting to change it one hour at each crossing of a time meridian.

"When the latitude reaches 90°, t is finite, being about 3.5 days. But, as one of you pointed out at a meeting two months ago, the longitude becomes infinite, and therefore the Greenwich time would have been minus infinity.

"So Nipp would have arrived at the Northeast Pole an eternity ago, Tuck's longitude being westward and negative, he would have reached the Northwest Pole an eternity hence, and Nipp would have had to wait those two eternities. According to his fancy, he could have considered all of this time as one eternity, just as twice infinity is considered infinity.

"It was fortunate that Nip and Tuck changed their rates so as to arrive in the present, for they told me of a most interesting sun dial they found mounted on top of the North Pole by citizens of Los Angeles interested in this suburban area of the city. The style was erected truly vertical from the center of the tablet, being properly pointed at the celestial pole. The dial was graduated into 24 equal parts, with a numeral at each point. Can you guess what these numerals were if I note that their sum was exactly 288?"

[*The first problem of this series* (*in* CIVIL ENGINEERING *for February*) *developed some argument, led by Prof. F. H. Constant, M. Am. Soc. C.E., who computed the time for the flight at 88 hours, agreeing reasonably with Professor Neare, while Ann Othernut, M. Am. Soc. C.E.* (*alias Prof. J. Charles Rathbun*) *warned that Nipp and Tuck would never reach that garden spot where south winds prevail and the climate and explorers are balmy.*]

Meeting on Political and Social Science

THE Forty-fourth Annual Meeting of the American Academy of Political and Social Science was held at the Bellevue-Stratford Hotel, Philadelphia, on Friday and Saturday, April 12 and 13, 1940. Included were delegates from 11 states, 10 cities, 87 universities and colleges, and 219 national and international associations and societies.

The occasion was concerned with the general topic, "The United States and Durable Peace." There were in all six sessions, with a total of 17 speakers, many of them American, but including also those from Chile, Switzerland, France, and Italy. The speakers generally contemplated the necessity of some kind of international organization for the preservation of peace, but the fundamental difficulties involved in such an accomplishment seemed to preclude definite plans which might offer reasonable promise of success. One American insisted upon the necessity of our importing liberally from Europe. He also suggested that we lend from our store of gold without interest and with long-term credits for enterprises of a genuinely productive nature.

Delegates of the Society were Francis P. Witmer and Dudley T. Corning, Members Am. Soc. C.E. From their report the foregoing summary has been drawn.

Training for Railway Service Instituted by A.R.E.A.

LOOKING to the future requirements of the railways for trained leadership in official positions, the American Railway Engineering Association has created a Committee on Cooperative Relations with Universities.

As set forth by the president of the Association, E. M. Hastings, M. Am. Soc. C.E., the functions of the committee will be to (1) stimulate greater cooperation between railway officials and officers of universities and colleges in preparing the best courses of instruction to meet changing railway problems; (2) call to the attention of universities and colleges such information and conclusions developed by the association as thought to be of special interest or value to them; (3) develop means of bringing to the attention of railway managements the value of a technical education as a qualifying factor for young men desiring to

enter railway service with a view to advancement; (4) stimulate a greater interest in the science of transportation among university and college students, and create thereby a greater appreciation of the place of transportation in our national economic structure; (5) develop means whereby facilities of the universities may be made more directly available for research work of the association and the railway industry by cooperative effort between the staffs of the universities and the committee of the association; (6) stimulate a greater appreciation among university and college authorities of the fundamental importance of instruction in transportation and economics, and of the necessity for assigning men of adequate ability, experience, and fitness for such teaching; (7) cooperate with organizations of university and college students engaged in study or discussion of engineering or transportation matters and contribute to their activities in such manner as may be mutually arranged. In the first of these functions, the committee will work closely with the committees on Transportation of the Society for the Promotion of Engineering Education.

This new committee, which includes nine railway men and five members of college faculties, will be headed by Elmer T. Howson, M. Am. Soc. C.E., western editor of *The Railway Age*.

Brief Notes from Here and There

ACCORDING to *Steel Facts* of the American Iron and Steel Institute, welding in the United States is making continuous progress, as measured by the use of welding wire. During 1939 the production of such wire totaled over 183,000,000 lb, the largest ever recorded. This quantity is 760% of the production in 1932; by comparison, steel ingot production in the same period increased less than 350%.

* * * *

THE AVAILABILITY of 19 graduate fellowships at the Bureau of Street Traffic Research, Yale University, beginning next September, is announced. These include the possibilities in the fields of state highway traffic engineering and of research traffic engineering. The total value of each fellowship is about $1,400, including tuition and expenses. Applications must be filed immediately. Inquiries may be directed to Maxwell Halsey, Room 311, Strathcona Hall, New Haven, Conn.

* * * *

WORTHY OF attention as reflecting progress in safety practices in the long-term achievement of the U. S. Navy's shore departments, which during the past 14 years have reduced injury compensations from $17.22 per employee to $0.86 per employee. Navy Secretary Charles Edison, giving these data in a recent letter to the 16th Eastern Safety Conference, went on to urge executives, engineers, and educators to develop formal professional and educational standards for safety engineers in the leading technical schools. The conference quotes him as follows: "I believe that existing hit-or-miss, haphazard development of safety engineers has reached its peak and little more can be accomplished in that direction until the science of safety engineering is developed along more exact and scientific lines."

* * * *

A REQUEST came recently to the Engineering Societies Library for the publisher of a book, *King Solomon's Mines*, of which the author's name was given as Hagerty. The title struck a responsive chord, and suddenly the realization came that romance is not dead. This was no dry-as-dust technical tome describing geological formations or ancient mine workings. It was a full-blooded tale of the lure of fabulous wealth written by that master of high adventure, H. Rider Haggard. The mundane details of publisher and price were furnished with pleasure. Along this same line it may be of interest to note that the Library possesses a novel with the title "Wired Love: a Romance of Dots and Dashes," published in 1880.

* * * *

FROM July 30 to August 8, the Second National Surveying Teachers' Conference is scheduled to be held at Case School Camps in the Mohican Forest Park, Ohio. This conference is sponsored by the Society for the Promotion of Engineering Education. The first such Conference, held in 1937, which was attended by 34 representatives of 28 engineering colleges, aroused considerable interest. For detailed information regarding the forthcoming one, address Prof. J. S. Dodds, M. Am. Soc. C.E., Chairman, General Committee on 1940 Conference, or Prof. M. S. Douglas, Assoc. M. Am. Soc. C.E., School of Applied Science, University Circle, Cleveland, Ohio.

* * * *

ANNOUNCEMENT has been made of the establishment of the Stanton Walker Fellowship at the University of Maryland by the National Sand and Gravel Association. This fellowship, which amounts to $600 a year, will be for research on appropriate problems related to the sand and gravel industry. It has been named by the Association for Stanton Walker, M. Am. Soc. C.E., director of engineering research for this organization during the past 14 years.

* * * *

WHAT HAS formerly been a week's Economics Conference, held at the Engineering Camp of Stevens Institute, at Johnsonburg, N.J., is to become this year a Management Conference. The dates are June 22 to June 30. Inquiries may be directed to the Stevens Institute of Technology, Hoboken, N.J.

* * * *

TWO professional meetings, on opposite sides of the continent, are scheduled for the week of June 24–28—the Society for the Promotion of Engineering Education meets at the University of California in Berkeley, and the American Society for Testing Materials meets at Atlantic City. Besides extensive sessions on civil engineering, the S.P.E.E. will hold conferences or meetings covering the topics of engineering drawing, engineering research, mathematics, soil mechanics, and personal development. The Golden Gate International Exposition and Stanford University also have prominent places on the program. Of special interest to engineers attending the A.S.T.M. meeting will be a symposium on the significance of tension tests in relation to design, and another on problems in the classification of natural waters intended for industrial use. Discussions of cement, concrete, petroleum products, non-ferrous metals, and plastics are also on the program.

* * * *

TEN high school graduates, selected on the basis of competitive examinations, character, and personality, will be paid $50 a month to go to Carnegie Institute of Technology for the next five years in a "work-learn" technical study program made possible by an appropriation by the Westinghouse Electric and Manufacturing Company. The plan includes practical experience in the Westinghouse plants as well as eight semesters of college class work at Carnegie Institute. When the program is in complete operation it will include fifty functioning scholarships, with ten becoming vacant every summer.

* * * *

THE latest edition of the "Index to A.S.T.M. Standards, Including Tentative Standards" gives information on all of the 885 standards as of January 1, 1940, and is of help in locating the standards in the volumes where they appear. All items are listed in the Index under appropriate keywords according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numerical sequence of their serial designations. Copies of this 152-page publication are furnished without charge on written request to the headquarters of the American Society for Testing Materials at 260 South Broad Street, Philadelphia, Pa.

* * * *

"ROADSIDE DEVELOPMENT" is the title of a 63-page mimeographed booklet recently issued by the Highway Research Board of the National Research Council. In addition to articles on roadside protection through comprehensive planning, highway location, roadside agronomy, and county zoning in Wisconsin, the volume includes the reports presented at the nineteenth annual meeting by the Joint Committee on Roadside Development of the Highway Research Board and the American Association of State Highway Officials. The booklet, which is fifty cents, may be obtained from the National Research Council in Washington, D.C.

* * * *

GRADUATE courses set up on a "short course" basis, so that an employed engineer may take advanced work during a 4-week vacation, are to be featured this summer

by Armour Institute of Technology in Chicago, in its Summer Graduate Institute of Engineering and Science. A wide selection of civil engineering subjects is available. There are three 4-week terms, beginning on June 17, July 15, and August 12. Full details can be secured from L. E. Grinter, dean of the Graduate Division.

* * * *

"IN THE CONSTRUCTION of Hiwassee Dam the TVA may take proper pride in the accident record," says *Construction Safety*, publication of the National Safety Council. No fatalities occurred in the construction work, although two men were killed in a quarry from which aggregate was taken. There were no permanent eye injuries on the entire project. The accident frequency rate was 28.0; the severity rate 3.22—"these figures being less than one-fourth the corresponding rates for a group of contractors engaged in heavy and railroad construction."

NEWS OF ENGINEERS

Personal Items About Society Members

ROGER W. ARMSTRONG has been promoted from the position of department engineer in the New York City Board of Water Supply to that of deputy chief engineer.

F. S. WITZIGMAN, until recently assistant engineer in the U.S. War Department at Minneapolis, Minn., has been transferred to Balboa, Canal Zone, where he is in charge of hydraulic research for the design of the new Panama locks.

GEORGE WILLIAM STEPHENS, JR., announces the formation of George William Stephens, Jr., and Associates, engineers and landscape architects, with headquarters in the Jenifer Building at Towson, Md. For the past twenty years Mr. Stephens has been chief engineer and landscape architect for the Roland Park Company, Baltimore, Md.

ROBERT BOEHNKE, formerly civil engineer for the American Rolling Mill Company at Middletown, Ohio, is now development engineer for the Clark Grave Vault Company at Columbus, Ohio.

E. V. R. PAYNE has established a civil engineering practice at 11 East Main Street, Mystic, Conn. Until lately he was engineer examiner for the PWA, with headquarters in New York City.

JOHN QUINCY JEWETT has been admitted to partnership in the consulting firm of Quinton, Code and Hill-Leeds and Barnard, Los Angeles, Calif., which has now changed its firm name to Leeds, Hill Barnard, and Jewett. Mr. Jewett was formerly hydraulic engineer with the firm.

FREDERICK LEE BROWNE, junior engineer in the Corps of Engineers, U.S. Army, has been transferred from the U.S. Engineer Office at Little Rock, Ark., to the Hawaiian District, with headquarters in Honolulu.

FRED M. VEATCH has been appointed district engineer for the U.S. Geological Survey at Tacoma, Wash. Until recently he was district engineer at Louisville, Ky.

C. V. MAXWELL, JR., formerly assistant structural engineer for Gardner and Howe, of Memphis, Tenn., has established an engineering practice at Jackson, Miss., under the name of Structural Engineering Service. He will specialize in reinforced concrete and structural steel work.

ALFRED E. LINDAU, civil engineer of Chicago, is at present in Hawaii, where he is making studies of concrete in connection with the new western Pacific air base work. He is investigating, in particular, the use of coral for coarse aggregate.

CLARENCE N. MORANG is now an associate engineer in the U.S. Forest Service, stationed at Greenfield, Mass. He was formerly hydraulic engineer in the U.S. Engineer Office at Providence, R.I.

W. E. R. COVELL, lieutenant-colonel, Corps of Engineers, U.S. Army, has left the army after twenty-nine years of service to begin new work as assistant to the general manager of Crosset-Watzek-Gates. For the past four years Colonel Covell has served as district engineer in the U.S. Engineer Office at Pittsburgh.

CORNELIUS W. KRUSE, assistant sanitary engineer with the Tennessee Valley Authority, is now on leave of absence at Harvard University, where he is taking special work in public health engineering.

ROBERT C. MCMORDIE has resigned as structural engineer for H. G. Acres and Company, Ltd., of Niagara Falls, Canada, to accept a position as designing engineer for the Hydroelectric Power Commission of Ontario, with headquarters in Toronto, Canada.

W. S. BARRETT, instructor in civil engineering at the University of Texas, has been awarded a scholarship for graduate study at Massachusetts Institute of Technology for the 1940–1941 school year.

FRANK A. BELOUSEK, formerly road consultant for the Caribbean Petroleum Company at Maracaibo, Venezuela, is now sales representative for the export department of the Caterpillar Tractor Company at Peoria, Ill.

ROBERT G. BOTTOMS, until lately in the U.S. Engineer Office at Little Rock, Ark., has been appointed junior hydraulic engineer in the U.S. Geological Survey. He is now located at Fort Smith, Ark.

P. O. ROBERTS has been made special agent in the Division of Investigations of the Chicago office of the PWA. He was previously examiner-reviewer in the Omaha office of this organization.

J. A. BAIRD, previously assistant chief engineer of the Alabama State Highway Department, has become director of operations for the WPA in Alabama.

JOHN E. FIELD, after four years as engineer-examiner for the PWA in Washington, D.C., has returned to private practice as consulting and supervising engineer, with headquarters in the Cooper Building, Denver, Colo. Mr. Field will specialize in hydraulics, covering design, construction, and the engineering problems in connection with controversies and litigations.

T. E. BLISS has been transferred from Fort Worth, Tex., where he was division engineer for the St. Louis, San Francisco and Texas Railway Company, to Chaffee, Mo., where he will serve in a similar capacity on the River Division of the same railroad.

MILTON HOWARD, III, is now junior engineering aide for the TVA at Paris, Tenn.

FORREST F. VARNEY, formerly assistant engineer in the Sacramento district office of the U.S. Engineer Office, has been placed in charge of the Fresno (Calif.) area office, which is completing a flood control survey of the Merced County streams.

ALLEN J. NEGROTTO announces the formation of the A. J. Negrotto Engineering Company, with headquarters in the Union Building, New Orleans, La. Until recently Mr. Negrotto was regional engineer for Region VI of the WPA, his territory comprising Arkansas, Louisiana, Mississippi, Oklahoma, and Texas.

ROBERT L. PRICHARD has resigned as office manager–engineer for C. H. Cook, Inc., of Buena Vista, Ga., to become district field engineer in the administrative section of the WPA. He is located at Marietta, Ga.

GILBERT H. DUNSTAN, formerly assistant professor of mechanics at the University of Alabama, has been made assistant professor of sanitary engineering there.

KLYDE Z. HUSTON is now in the Second New Orleans (La.) Engineer District of the U.S. War Department. He was formerly civil engineering aide in the U.S. Engineer Office at Galveston, Tex.

MARTIN KINDINGER, until recently roads engineer for the City Council of Pretoria, Union of South Africa, has accepted a position as resident engineer for the Ungeni Water Scheme and is located at Durban, Union of South Africa.

B. F. HATCH has resigned as assistant engineer in the Ohio State Department of Health in order to become associated with Burgess and Niple, civil and sanitary engineers of Columbus, Ohio.

R. R. LUKENS, for the past four years commander and inspector in charge of the San Francisco Field Station of the U.S. Coast and Geodetic Survey, has been transferred to Manila, P.I., where he will be director of Coast Surveys, a bureau of the Philippine Island Commonwealth carrying on the charting of coastal waters.

GLENN B. WOODRUFF, for the past eight and a half years engineer of design on the San Francisco–Oakland Bay Bridge, has opened an office in the Russ Building, San Francisco, as a consulting civil engineer. He proposes to specialize in structures, foundations, and traffic problems.

JOSEPH D. LEWIN is now with the New York City Board of Water Supply, engaged on the Delaware water supply project. Until lately he was an associate engineer in the U.S. Engineer Office at Boston, Mass.

J. R. EGAN, formerly project supervisor for the WPA at Albion, Nebr., has been appointed area engineer for the WPA in Dixon, Dakota, Knox, and Cedar counties in Nebraska. His headquarters are at Hartington, Nebr.

MELVIN L. ENGER and THOMAS H. WIGGIN are co-winners for 1940 of the John M. Goodell Prize for the outstanding paper given before the American Water Works Association. The prize, which takes the form of a cash award, was established by the *Engineering News-Record* in 1931 in memory of a former editor.

MARSHALL WILLIAMS has announced his retirement as assistant to the president of the American Bridge Company after forty-two years of continuous service with the company and its predecessors.

PAUL C. GRUETER is now assistant engineer in the U.S. Engineer Department at Boston, Mass. He was formerly junior engineer.

RALPH W. HUNTER, town engineer for Neptune Beach, Fla., was elected Grand Chef de Gare of Florida's Grand Voiture of the 40 and 8, which convened in St. Petersburg, Fla., on the eve of the opening of the American Legion's twenty-second annual convention.

HAROLD W. RICHARDSON, associate editor of *Engineering News-Record*, has been transferred from New York to the Chicago office of the publication, which is in the McGraw-Hill Building at 520 North Michigan Avenue.

ARMANDO PEREIRA, tile and brick manufacturer of São Paulo, Brazil, has been nominated president of the Rotary International for the year 1940–1941. Since no other candidate was presented for consideration, Mr. Pereira's nomination is tantamount to election, the actual election to take place at the 1940 Rotary convention, to be held in Havana, Cuba, June 9 to 14.

DECEASED

ISAAC NEWTON CARTER (M.'40) professor of civil engineering at the University of Idaho, died suddenly on April 8, 1940, at the age of 49. From 1918 to 1920 Professor Carter was with the U.S. Bureau of Reclamation at El Paso, Tex. From 1923 on he was at the University of Idaho, where he was, successively, student instructor, instructor, assistant professor of civil engineering, associate professor of civil engineering, and (since September 1939) full professor. He was the author of a standard text on the theory and practice of engineering drawing.

GEORGE WILLIAM CHICKERING (M. '21) engineer and specification writer for Harold R. Duffie, of Boston, Mass., died suddenly on March 14, 1940. He was 70. Mr. Chickering was a member of the architectural firm, Chickering and O'Connell, of Boston, from 1894 to 1912, and in private engineering practice from the latter year till 1917. He resumed his practice after war-time service in the army and, later, was in the New York State Department of Architecture and with E. B. Badger and Sons Company, of Boston.

WALLACE BRYANT EVANS (Assoc. M. '30) with the J. G. White Engineering Corporation at Port-au-Prince, Haiti, was killed in an airplane accident at Jérémie, Haiti, on October 11, 1939. He was 41. At various times Mr. Evans was in the employ of the U.S. Bureau of Reclamation, and for several years was job engineer on the construction of copper and lead smelters for the Phelps Dodge Corporation at Douglas, Ariz. He had also done irrigation work in Arizona, California, and Mexico.

JOHN BELL MCRAE (M. '13) consulting engineer of Ottawa, Canada, died there on April 8, 1940, at the age of 64. In 1898 Mr. McRae joined the staff of the Canadian Atlantic Railway, and later engaged in hydroelectric work for C. H. Keefer, civil engineer of Ottawa. From 1904 on he was with the Ottawa consulting firm, McDougall and McRae.

CHRISTOPHER ELIAS SHERMAN (M. '27) professor emeritus of civil engineering at Ohio State University, died on May 6, 1940, after an illness of several months. He was 70. Professor Sherman joined the faculty of Ohio State in 1896, and for 36 years, beginning in 1902, was chairman of its department of civil engineering. Active in public affairs, he served the state as the governor's representative on the Ohio Cooperative Topographic Survey in cooperation with the U.S. Geological Survey, from 1902 to 1936, and under his direction Ohio was the first state in the Union to be completely mapped. He was also chief engineer and, later, chairman of the Scioto Sandusky Conservancy District, and took a leading part in water conservation in the state.

WILLIAM STEWART THOMSON (M. '17) consulting engineer of Granville, Ohio, died on April 21, 1940, at the age of 60. From 1906 to 1931 Mr. Thomson was with the Corrugated Bar Company and its successor, the Kalman Steel Company, holding positions successively as, assistant engineer, district manager of the Chicago office, assistant chief engineer, and chief engineer. Later—1933 to 1938—he was secretary of the Concrete Reinforcing Steel Institute, of Chicago, Ill.

ROBERT WILLIAM WADDELL (M. '01) city engineer of Kansas City, Mo., died in that city on April 19, 1940, at the age of 80. Early in his career Mr. Waddell was assistant engineer of water works at Omaha, Nebr., and later was engaged in general engineering work in Denver. In 1900 he was appointed city engineer of Kansas City, resigning in 1903 to return to private practice. In 1918 he again became city engineer of Kansas City, serving in that position (except for a brief period in 1925 and 1926) until his death.

Changes in Membership Grades

Additions, Transfers,, Reinstatements, and Resignations

From April 10 to May 9, 1940, Inclusive

ADDITIONS TO MEMBERSHIP

ABRAMS, ABRAHAM (Jun. '39), 765 East 175th St., New York, N.Y.

ADAMS, CHARLES MACLAIN (Jun. '39), Junior Engr. (Structural), U.S. Engrs., 751 South Figueroa (Res., 316½ South Witmer St.), Los Angeles, Calif.

BACHAND, EMILE PATRICK (Jun. '39), Junior Engr., FCS, Grade 9, U.S. Bureau of Reclamation, Post Office Bldg., Sunnyside, Wash.

BEARD, LEO ROY (Jun. '39), Junior Engr., Hydraulics Section, U.S. Engr. Dept., 751 South Figueroa, Los Angeles, Calif.

BEER, JUSTIN SQUIRES (Assoc. M. '40), Engr., Edmund J. McCormick, Inc., 215 Montague St. (Res., 1546 West 2d St.), Brooklyn, N.Y.

BODHAINE, GEORGE LAWRENCE (Jun. '40), Route 2, Box 529, Puyallup, Wash.

BOOK, JOSEPH EMANUEL (Jun. '40), Junior Engr., U.S. Engrs., 402 Chamber of Commerce Bldg. (Res., 5662 Forbes St.), Pittsburgh, Pa.

BRUMER, MILTON (Assoc. M. '40), Design Engr., O. H. Ammann, 111 Eighth Ave., Room 1513, New York, N.Y.

BUE, CONRAD DAHL (Assoc. M. '40), Asst. Hydr. Engr., U.S. Geological Survey, 412 Federal Bldg., Helena, Mont.

BUGAS, JOHN JOSEPH (Jun. '39), Res. Engr., Walter W. Flora, 821 East 17th, Cheyenne Wyo.

BURKEY, JOSEPH RAYMOND (M. '40), Cons. Engr., 2421 Plymouth Ave., Columbus, Ohio.

CAPLAN, SALEM DAVID (Assoc. M. '40), Junior Civ. Engr., Dept. of Water and Power, 207 South Broadway (Res., 1617½ Rendall Pl.), Los Angeles, Calif.

CARROLL, MARION EDMUND (Assoc. M. '40), Asst. Engr., International Boundary Comm. (Res., 388 South Reagan Ave.), San Benito, Tex.

CENTOLA, GIUSEPPE (Assoc. M. '40), Civ. Engr., Instituto Geografico do Brazil, Ltd., Rua 7 Setembro 54 (Res., Rua Duvivier 43, Apt. 43), Rio de Janeiro, Brazil.

CLAIBORNE, LEWIS EDMOND, JR. (Jun. '39), Instr., Civ. Eng., Mississippi State College, Box 161, State College, Miss.

COLLINS, LOREN DALE (Jun. '39), Junior Engr., U.S. Engr. Dept., Federal Bldg., Cincinnati, Ohio.

COOPER, ELBERT LEE (M. '40), Civ. Engr., Box 115, Brownington, Mo.

CRAWFORD, RAYMOND ROPER (Jun. '40), Chainman, Richfield Oil Corp., Los Angeles (Res., 1148 Magnolia St., Gardena), Calif.

CROSSLEY, NIXON FRANK (Assoc. M. '40), Engr., Met. Water Dist. of Southern California, 306 West 3d St., Los Angeles (Res., 281 East Jefferson Ave., Pomona), Calif.

CULBERTSON, JAMES FRANKLIN (Jun. '39), Insp., U.S. Bureau of Reclamation, Box 855, Redding, Calif.

CULBREATH, MARK CARNAHAN (Assoc. M. '40), Asst. Office Engr., Burns & McDonnell Eng. Co., 107 West Linwood (Res., 7119 Grand), Kansas City, Mo.

CUNNINGHAM, PHILIP EDWARD (Jun. '40), Senior Project Engr., WPA, 1740 South 84th St., West Allis (Res., 4773 North Cramer St., Milwaukee), Wis.

DAVIS, ALEXANDER BARNETT (Assoc. M. '40), Structural Engr., Metcalf & Eddy, Boston (Res., 11 Westmore Rd., Dorchester), Mass.

DEADY, WAYNE J. (Assoc. M. '40), Associate Bridge Engr., State Div. of Highways, Box 1499, Sacramento (Res., 480 East Ave., Turlock), Calif.

DETHOFF, DONALD COMPPEN (Jun. '39), With John C. Dethoff & Sons, 1600 Hampden Blvd., Reading, Pa.

DUBY, ROBERT VON KLEIST (Jun. '39), Structural Draftsman, Am. Bridge Co., Ambridge (Res., 602 Seventh St., Patterson Heights, Beaver Falls), Pa.

EICHLER, JOHN ORAN FRANCIS (Assoc. M. '40), Instr., Civ. Eng., Syracuse Univ., Syracuse, N.Y.

ENGSTROM, HAROLD JAMES, JR. (Jun. '39), Engr., Arkansas Foundry Co., 1501 East 6th, Little Rock, Ark.

ERB, CARL LEE, JR. (Jun. '40), Office Engr., The Central Nebraska Public Power and Irrig. Dist., Ogallala, Nebr.

EVANS, LEWIS VINCENT, III (Jun. '40), Junior Cartographic Engr., U.S. Coast and Geodetic Survey (Res., 2706 Woodley Pl.), Washington, D.C.

FALEY, THOMAS EDWARD (Jun. '40), Structural Draftsman, Pennsylvania Water & Power Co., Lexington Bldg. (Res., 5327 Wesley Ave.), Baltimore, Md.

FERBER, ROBERT ARNOLD (Jun. '40), With Am. Bridge Co. (Res., 110 Walnut St.), Elmira, N.Y.

FISHER, JOHN LERG (Jun. '40), Detailer, Bigelow & Liptack Corp., Grand Blvd. (Res., 15767 Westbrook Ave.), Detroit, Mich.

HARDISON, CLAYTON HAINES (Jun. '40), Junior Hydr. Engr., U.S. Geological Survey, Box 56 (Res., 120 Prospect St.), Montgomery, Ala.

HARGER, CARL (Jun. '39), Junior Engr., Eastman Kodak Co., Kodak Park Works (Res., 296 Aldine St.), Rochester, N.Y.

HAUSSLER, ROBERT WALTER (Jun. '39), Junior Engr., U.S. Engr. Dept., 316 West 5th (Res., 519 South Van Ness), Santa Ana, Calif.

HAYWOOD, OLIVER GARFIELD, JR. (Jun. '40), Lieut., U.S.A., War Dept., Washington, D.C. (Res., 124 Walker St., Cambridge, Mass.)

HEALY, JOHN EDWARD (Jun. '40), Junior Engr., John E. Healy & Sons, 707 Tatnall St. (Res., 1005 North Rodney St.), Wilmington, Del.

HICKS, JAMES MOYER (Assoc. M. '40), Asst. Engr., U.S. Engr. Office, 909 Calvert Bldg., Baltimore, Md.

HOBBS, MERRILL HOPKINS (Assoc. M. '39), Cons. Engr., 808 Seventeenth St., N.W., Washington, D.C. (Res., 1529 West Falkland Lane, Silver Springs, Md.)

HOLDEN, OTTO (M. '40), Chf. Hydr. Engr., Hydro-Elec. Power Comm. of Ontario, 620 University Ave., Toronto, Ont.

HOLLYFIELD, JOHN BURGIN (Assoc. M. '40), Asst. Structural Engr., TVA, 201 Arnstein Bldg., Knoxville (Res., 147 Orchard Rd., Norris), Tenn.

HUDSON, GEORGE HENRY (M. '39), Senior Engr., U.S. Engr. Dept., 620 Union Bldg., New Orleans, La.

HUMMEL, RICHARD JACOB (Assoc. M. '40), Location Engr., State Highway Board, 166 North West 100th St., Miami Shores, Fla.

HUNT, JAMES JOSEPH (Jun. '39), Civ. Engr., Great Lakes Dredge & Dock Co., Williamson Bldg. (Res., 1216 East 87th St.), Cleveland, Ohio.

JOHNSON, REUBEN JOSEPH (Jun. '39), Asst. Eng. Aid, Public Roads Administration, Federal Office Bldg., San Francisco (Res., 6138 Plumas Ave., Richmond), Calif.

KALINSKE, ANTON ADAM (Assoc. M. '39), Asst. Prof., Univ. of Iowa, Iowa Inst. for Hydr. Research, Iowa City, Iowa.

KAZMANN, RAPHAEL GABRIEL (Jun. '39), Junior Hydr. Engr., Ground Water Div., U.S. Geological Survey (Res., 1404 Tuckerman St., N.W.), Washington, D.C.

KENNEDY, JOHN SEATON (Jun. '40), Civ. Engr., British Columbia Bridge & Dredging Co., Ltd., 510 West Hastings St. (Res., 3281 West 3d Ave.), Vancouver, B.C.

KINZER, HAROLD DAVID (Jun. '39), Asst. Supt., Refinery Constr., McColl Frontenac Oil Co., Ltd., Cherry and Commissioners (Res., 193 St. George St.), Toronto, Ont.

LACEY, HUGH HILDEN (Jun. '39), 140 East 36th St., Indianapolis, Ind.

LAND, WILBUR EARLE (Assoc. M. '40), Gen. Supt., Maintenance and Const. Dept., Asociacion Azucarera Cooperativa Lafayette, Arroyo, Puerto Rico.

LEBBY, THOMAS DOTTERER (M. '40), Div. Supt., TVA (Res., 204 Ridge Ave.), Chattanooga, Tenn.

LIPPA, EUGENE (Jun. '39), Engr., Standard Oil Co. of California, 265 Bush St. (Res., 2810 Franklin St.), San Francisco, Calif.

LITTLETON, EARLE FREDERICK (Assoc. M. '39), 39 Myrtle St., East Dedham, Mass.

MACARTNEY, THOMAS WAKEFIELD (Jun. '40), Graduate Asst., Civ. Eng., Univ. of Idaho, Moscow, Idaho.

MCCORDIC, GEORGE WILFRID (M. '40), Sec. Mgr., Port of Detroit Comm., 3902 Barlum Tower (Res., 14500 Abington Rd.), Detroit, Mich.

MCKEEGAN, JAMES JOSEPH (Assoc. M. '40), Transitman, Grade 4, New York City Tunnel Authority, 200 Madison Ave. (Res., 615 Fort Washington Ave.), New York, N.Y.

MCLEAN, LOUIS KENNETH (Jun. '40), BR-61, Bayard, Nebr.

MANN, CARROLL LAMB, JR. (Assoc. M. '40), Res. Engr., Housing Authority, City of Raleigh, 815 Harp St., Raleigh, N.C.

MIDDLETON, ROGER WESLEY (Jun. '39), Rodman, C. M. St. P. & P. R. R., Milwaukee Station (Res., 104 Seventh, S.E.), Aberdeen, S.Dak.

MIGONE, LOUIS VICENTE (M. '40), Civ. Engr., Ave. Alvear 3186, Buenos Aires, Argentina.

MURDAUGH, CLAUDIUS WALKE (Assoc. M. '40), Care, Eng. Dept., B. & O. R. R., Goff Bldg., Clarksburg, W.Va.

NUNN, EDWARD HAMILTON (Assoc. M. '39), Constr. Engr., State Roads Comm., Federal Reserve Bank Bldg., Baltimore (Res., 105 Hilton Ave., Catonsville), Md.

ORR, NOLAN BRISTOW (Assoc. M. '39), Supervising Engr., State Highway Comm., State House Annex, Indianapolis, Ind.

OWENS, GEORGE EDWARD (Assoc. M. '40), Contract Engr., Massman Constr. Co., 737 New York Life Bldg., Kansas City, Mo.

PATTISON, CHARLES PHILLIP (Jun. '39), Care, Arrowhead Iron Works, 431 West 5th St., Kansas City, Mo.

PETERSON, THOMAS HUGH (Jun. '40), Asst. Engr., U.S. Engr. Office, Pittock Block, Portland, Ore.

RAIT, ROBERT ALEXANDER (Assoc. M. '40), Engr., Phillips Petroleum Co., Box 805, Phillips, Tex.

RANDALL, GEORGE HAROLD (M. '40), Prin. Asst. Engr., Modjeski & Masters, State St. Bldg., Harrisburg, Pa.

RIST, HAROLD WILLIAM (Jun. '39), Draftsman, Babcock & Wilcox Boiler Co., 505 Wooster Rd., West, Barberton, Ohio. (Res., 603 Market St., Wheeling, W.Va.)

ROBERTS, JOHN WATTS (Jun. '39), 4824 A Chamberlayne Ave., Richmond, Va.

SAIN, KANWAR (M. '39), Executive Engr., Irrig. Dept., Irrigation Secretariat, Lahore, India.

SALLY, JOSEPH FRANK (Jun. '40), Estimator and Structural Designer, The Austin Co., 19 Rector St., New York (Res., 21–16 Thirty-Fifth St., Astoria), N.Y.

SCHAD, THEODORE MACNEEVE (Jun. '39), Eng. Aide, U.S. Engr. Dept., Baltimore, Md.

SCHEID, PAUL GEORGE (Jun. '40), Asst. Div. Engr., Great Lakes Dredge & Dock Co., 740 North Plankinton Ave., Milwaukee, Wis.

SCHMOKEL, MELVIN HENRY (Jun. '39), Asst. Engr., Gen. Petroleum Co. (Res., 6434 North Missouri), Portland, Ore.

SEARLES, ARTHUR EDMUND (Assoc. M. '40), Vice-Pres., J. W. Beretta Engrs., Inc., 1205 National Bank of Commerce Bldg., San Antonio, Tex.

SHAW, HOWARD EARLE, JR. (Jun. '40), Director, Dept. of Sanitation, Calvert Distilling Co., Relay (Res., 270 Winans Ave., Halethorpe), Md.

SKEELS, JOHN HERBERT FRANKLIN (Jun. '39), With Pacific Gas & Elec. Co., Martinez (Res., 190 Orange St., Auburn), Calif.

SOULE, CARLTON MANSON (M. '40), Associate Engr., J. E. Greiner Co., 1201 St. Paul St. (Res., 4008 Norfolk Ave.), Baltimore, Md.

SUHR, LEWIS DELMAR (M. '40), (Suhr-Berryman-Peterson & Suhr, Inc.), 130 North Wells, Chicago (Res., 911 Sheridan Rd., Evanston), Ill.

TASHPINAR, AFFAN HALET (Jun. '40), Engr., H. A. Brassert & Co., Ltd., Belvu Palas, Ankara (Res., Bostan Araligi 13, Bebek, Istanbul), Turkey.

TILESTON, Fred Marion (Jun. '39), Materials Laboratory Asst., State of Idaho, 23d and Main (Res., 1604 North 16th St.), Boise, Idaho.

WIBE, HENRY TEGNANDER (Jun. '40), Junior Engr., U.S. Engr. Dept., 209 Pittock Block (Res., 2181 North West Glisan), Portland, Ore.

WOOD, FRANK BURTON (Assoc. M. '40), Associate Engr. (San.), U.S. Engr. Dept., Vicksburg, Miss.

ZWERNER, GENE ARTHUR (Jun. '40), Asst. Engr., U.S. Dept. of Agriculture, SCS, 716 Columbian Bldg. (Res., 5616 Thirteenth St., N.W.), Washington, D.C.

TOTAL MEMBERSHIP AS OF MAY 9, 1940	
Members	5,631
Associate Members	6,448
Corporate Members	12,079
Honorary Members	31
Juniors	4,223
Affiliates	70
Fellows	1
Total	16,404

MEMBERSHIP TRANSFERS

ANDERSON, RHUEL ANDREW (Jun. '37; Assoc. M. '40), Asst. Structural Engr., TVA, 300 Arnstein Bldg., Knoxville (Res., 317 Tazewell Pike, Fountain City), Tenn.

ANDERSON, EDWARD CAREW (Jun. '30; Assoc. M. '39), Engr., The Permanente Corp., Box 29, San Jose (Res., 319 Stevens Creek Rd., Cupertino), Calif.

AX, CLARENCE HERMAN (Jun. '30; Assoc. M. '39), Engr., Portland Cement Assn., 915 Olive St. (Res., 5570 Cates Ave.), St. Louis, Mo.

BLAIR, PAUL MCGREARY (Jun. '28; Assoc. M. '39), Associate Engr. (Hydr.), Federal Power Comm., 18th and Pennsylvania Ave., Washington, D.C. (Res., 1850 Sudbury Rd., Silver Spring, Md.)

BOARD, LEONARD MARVIN (Jun. '31; Assoc. M. '39), Public Health Engr., St. Louis County Health Dept., Box 116, Clayton, Mo.

HAINES, REUBEN MATTER (Jun. '35; Assoc. M. '40), Engr., U.S. Engrs., U.S. Engr. Office, 5 Tremont St., Concord, N.H.

HALLVIK, CARL CLIFFORD (Jun. '32; Assoc. M. '40), Materials Engr., State Bureau of Highways, 27th and Main, Boise, Idaho.

HANSON, ARTHUR HENRY (Jun. '32; Assoc. M. '40), Associate Cartographic Engr., U.S. Dept. of Agriculture, 151 South State St., Salt Lake City, Utah.

HART, ORVILLE HAVEN (Jun. '27; Assoc. M. '40), Associate Engr., War Dept., U.S. Engr. Office, Post Office Bldg. (Res., 360 Thirty-Sixth Way), Sacramento, Calif.

HILTON, DONALD CROSS (Jun. '31; Assoc. M. '40), With Byrd Expedition, 126 Rockingham St., Rochester, N.Y.

HUBBELL, CHARLES WHEELER (Jun. '28; Assoc. M. '39), 1513 Johnstone Ave., Bartlesville, Okla.

JANCIK, EDWARD CHARLES (Jun. '35; Assoc. M. '39), Sales Engr., Texas Constr. Material Co., 2905 Milam St., Houston, Tex.

LAMB, JOHN FEREBEE (Assoc. M. '27; M. '40), Field and Drainage Engr., Imperial Irrig. Dist., Box 7, Imperial, Calif.

MORTON, WILLIAM (Jun. '35; Assoc. M. '39), Constr. Foreman, U.S. Coast Guard, Florence, Ore.

MURPHY, GLENN (Jun. '29; Assoc. M. '40), Associate Prof., Theoretical and Applied Mechanics, 101 Laboratory of Mechanics, Iowa State College, Ames, Iowa.

PAIGE, CLAYTON WHITNEY (Assoc. M. '29; M. '40), City Engr. and Supt. of Streets, City Hall, Alhambra, Calif.

PARKER, CHARLES VICTOR (Jun. '31; Assoc. M. '39), Junior Engr., U.S. Engrs., Gay Bldg. (Res., 224 Barton), Little Rock, Ark.

POLISSON, PAUL ANGEL (Jun. '35; Assoc. M. '40), City Engr., City Hall, Gloucester, Mass.

RUDDER, IRVING AVRUM (Jun. '34; Assoc. M. '40), Structural Draftsman, Grade 4, Office of Pres., Boro of Manhattan, 2134 Municipal Bldg. (Res., 2104 Bronx Park East), New York, N.Y.

SAXE, VAN RENSSELAER POWELL (Jun. '08; Assoc. M. '16; M. '40), Cons. Engr., 100 West Monument St., Baltimore, Md.

SUPPIGER, EDWARD WASHINGTON (Jun. '28; Assoc. M. '39), Associate, Theoretical and Applied Mechanics, Univ. of Illinois, 317 Talbot Laboratory (Res., 1010 South Orchard St.), Urbana, Ill.

WILLARD, ROGER HERSPBARGER (Jun. '32; Assoc. M. '40), County Roads Engr., Frederick County Roads Board, Court House (Res., 105 West 3d St.), Frederick, Md.

WOJDYGO, JOSEPH MORTIMER (Jun. '28; Assoc. M. '40), Asst. Civ. Engr., The San. Dist. of Chicago, 910 South Michigan Ave. (Res., 6408 South Troy St.), Chicago, Ill.

REINSTATEMENTS

COWIN, JAMES, M., reinstated April 22, 1940.

GOULD, STEPHEN GROVER, Assoc. M., reinstated April 13, 1940.

HUNT, JAMES O'CONNOR, M., reinstated April 23, 1940.

KELCH, NORMAN WALLACE, Assoc. M., reinstated April 22, 1940.

STUBBS, HENRY FRANKLIN, Assoc. M., reinstated April 16, 1940.

WESTMAN, JOHN FRANKLYN, JR., Jun., reinstated April 23, 1940.

RESIGNATIONS

ELAM, DANIEL FRANK, Jun., resigned March 21, 1940.

LAIRD, ARTHUR EDWARD, Jun., resigned May 7, 1940.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

June 1, 1940 NUMBER 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ABBETT, ROBERT WILLIAM (Assoc. M.), Schenectady, N.Y. (Age 37) (Claims RC 10.8 D 2.6) Aug. 1933 to July 1938 Asst. Prof., and Sept. 1939 to date Associate Prof., of Bldg. Constr., Union Coll.; in the interim Associate in firm, Parsons, Klapp, Brinckerhoff & Douglas, New York City.

AKERS, JAMES BYRNSIDE, Washington, D.C. (Age 56) (Claims RCM 28.5) April 1906 to date with Southern Ry. System as Asst. Supervisor, Transitman, Asst. Engr., Acting Engr., and Engr., M.-of-W. Dept., Chf. Engr., Asst. to Vice-Pres., and (since Aug. 1931) Asst. Chf. Engr.

ALEXANDER, JOHN BILLINGS (Assoc. M.), Denison, Tex. (Age 43) (Claims RCA 8.6 RCM 6.3) Sept. 1930 to date with U.S. Engrs., as Associate Hydr. Engr., Associate Engr., Engr., Senior Engr., and Prin. Engr.

BACKMAN, LESTER JOHN, Cincinnati, Ohio. (Age 52) (Claims RCA 24.8) Sept. 1919 to date Engr., The Ferro Concrete Constr. Co.

BLANKS, ROBERT FRANKLIN, Denver, Colo. (Age 39) (Claims RCA 3.3 RCM 10.8) Oct. 1930 to date Civ. Engr., U.S. Bureau of Reclamation.

BRANT, FREDERICK RUSSELL, Washington, D.C. (Age 39) (Claims RC 9.6 D 3.5) Sept. 1933 to date with National Park Service, Dept. of the Interior (since July 1939 FWA, PBA) as Asst. Structural Engr., etc., and (at present) Bldg. Supt.-Engr.

BROWN, WENDELL STIMPSON, Providence, R.I. (Age 51) (Claims RCA 6.0 RCM 15.0) 1911 to date with F. P. Sheldon and Son, Engrs. and Archts., Providence, R.I., designing, drafting, and acting as Res. Engr. in field on reinforced concrete, steel, and mill construction.

CANALS, JOSE MANUEL (Assoc. M.), San Juan, Puerto Rico. (Age 40) (Claims RCA 8.7 RCM 5.9) Sept. 1934 to date Civ. Engr. (private practice).

ELKIND, BENJAMIN, Cleveland, Ohio. (Age 51) (Claims RCA 3.0 RCM 18.3) Aug. 1919 to date with Erie R.R. Co., as Track Supervisor, Eng. Accountant, Estimating Engr., and Chf. Draftsman, etc.

HARRINGTON, PHILIP, Chicago, Ill. (Age 54) (Claims RCA 4.3 RCM 23.3) July 1935 to date with City of Chicago, as Traction Engr., Commr. of Subways and Traction, and (since Jan. 1940) Commr. of Subways and Superhighways.

HOLCOMBE, WILLIAM HENRY, Milwaukee, Wis. (Age 48) (Claims RCM 19.1) Sept. 1914 to date with U.S. Army as Lieut., Capt., and Lt. Col., Corps of Engrs.; since July 1936 acting as Dist. Engr., Milwaukee Engr. Dist.

KETCHUM, VERNE LEE, Portland, Ore. (Age 49) (Claims RCA 12.0 RCM 12.0) 1936 to date Cons. Engr. (private practice); previously Designing Engr., U.S. Govt., War Dept., Bonneville Sec.

KRAUSS, WOLFGANG WALTER (Assoc. M.), Cleveland, Ohio. (Age 39) (Claims RCA 2.9 RCM 7.3) Sept. 1939 to date Cons. Engr., Republic Steel Corporation; previously Asst. Mgr., Housing Div., Truscon Steel Co., Youngstown, Ohio; Cons. Engr., Berger Mfg. Co., Canton Ohio; Cons. Engr. for Pope W. Barney and Kastner & Stonorov, Associate Archts., and for Kastner & Stonorov, Archts., Philadelphia, Pa.

MCNEAL, DONALD HAMLIN (Assoc. M.), Washington, D.C. (Age 39) (Claims RC 14.3) 1934 to date with HOLC and FHLBB, at present being Deputy Gen. Mgr. and Tech. Director.

NELIDOV, IVAN MANUELOVICH (Assoc. M.), Sacramento, Calif. (Age 46) (Claims RCA 9.0 RCM 8.7) Oct. 1929 to date with Dept. of Dams, California Div. of Water Resources as Associate Engr. and (since July 1931) Senior Engr.

OWEN, LEWIS REES, Johnstown, Pa. (Age 51) (Claims RCM 24.4) Jan. 1916 to date in private practice on design and construction of streets, sewers, roads, and bridges, etc.

PYLE, MILTON ALLENDER, College Park, Md. (Age 45) (Claims RCA 0.5 RCM 9.3) 1918 to June 1932 Instructor in, and Sept. 1932 to date Asst. Prof. of, Civ. Eng., Univ. of Maryland.

SNEARY, LOY E., Kansas City, Mo. (Age 55) (Claims RCA 2.1 RCM 17.8) Feb. 1940 to date Director, Water Dept., Kansas City, Mo.; previously with PWA as Res. Engr. Inspector, FWA, Ohio, and Engr. Special Agt., Div. of Investigations, Region No. 7, Kansas City, Mo.

SPANGLER, MERLIN GRANT (Assoc. M.), Ames, Iowa. (Age 45) (Claims RC 20.3 D 17.9) Feb. 1924 to date Asst. Engr., Associate Struc-

tural Engr., Research Associate Prof. of Civ. Eng., Iowa Eng. Experiment Station, Iowa State Coll.

WAGNER, CHARLES HENRY, Dayton, Pa. (Age 34) (Claims RCA 4.0 RCM 5.3) June 1923 to Feb. 1924 and June 1926 to date with U.S. Engr. Office as Inspector, Surveyman, Jun. Engr., Asst. Engr., Associate Engr., and (since Jan. 1935) Engr.

WHITE, JOSEPH HENRY, Balboa Heights, C.Z. (Age 37) (Claims RCA 5.3 RCM 6.5) March 1940 to date with The Panama Canal, as Estimating Engr., Specification Writer and preparing states orders; previously with Moore & Haller, Inc., Cambridge, Mass.; Cost Engr., Turner Constr. Co., Boston; with Sawyer Constr. Co., Boston; Structural Engr., B. F. Goodrich Co., Akron, Ohio.

APPLYING FOR ASSOCIATE MEMBER

ARCHIBALD, THOMAS RICHIE, Rochester, N.Y. (Age 47) (Claims RCA 21.0) Sept. 1921 to Nov. 1923 and April 1926 to date Constr. Engr., Board of Education.

BLIFFERT, WESLEY PHIL, Milwaukee, Wis. (Age 33) (Claims RCA 6.0) April 1934 to date Engr., Tews Lime & Cement Co.

BRETT, THOMAS BRONSON (Junior), Pittsburgh, Pa. (Age 32) (Claims RCA 4.8) June 1930 to date with U.S. Engr. Office successively as Inspector, Jun. Engr., Asst. Engr., and (since Feb. 1940) Associate Engr.

BRINKMAN, HARRY WILLIAM (Junior), Phoenixville, Pa. (Age 33) (Claims RCA 4.2) June 1930 to Sept. 1935 and Feb. 1936 to date Structural Steel Detailer, The Phoenix Bridge Co.

CANTINE, THOMAS ROBINSON (Junior), Portland, Ore. (Age 32) (Claims RCA 3.3 RCM 0.8) May 1934 to date with U.S. Engr. Dept., as Jun. Engr., and (since Feb. 1935) Asst. Engr.

CLICKENER, CORWIN KING (Junior), Duluth, Minn. (Age 29) (Claims RCA 2.4) Nov. 1937 to date Instructor in Civ. Eng., Mathematics and Drafting, Duluth (Minn.) Junior Coll.; previously Jun. Engr., Illinois Div. of Highways.

COBERLY, CARROLL H., Denver, Colo. (Age 56) (Claims RCA 21.0) May 1917 to date in private practice, land surveying, irrigation, and municipal work.

DIETZ, ALBERT GEORGE HENRY, Belmont, Mass. (Age 32) (Claims RCA 3.3) 1934 to date Asst. and Instructor, Massachusetts Inst. of Technology.

DIVEN, JAMES BARRY, JR., Baton Rouge, La. (Age 31) (Claims RCA 3.3) Sept. 1935 to date with E. I. du Pont de Nemours & Co., as Engr., and since Feb. 1939 Asst. Engr.; previously Asst. Chf. Steel Inspector and Steel Inspector, Pennsylvania R.R. Co.

EBERLE, RUDOLPH EUGENE (Junior), Emporia, Kans. (Age 28) (Claims RCA 1.8) Feb. to March 1935 and July 1938 to date with Paulette & Wilson, Engrs., Salina, Kans., as Instrumentman, and (since Aug. 1938) Res. Engr.; in the interim Materials Clerk, Acting Inspector, and Asst. Engr., Panhandle Eastern Pipe Line Co., Kansas City, Mo.; Sub-Inspector, U.S. Engrs., St. Louis, Mo.; Asst. Engr., Kansas Div. of Water Resources, Topeka, Kans.

ELLIS, BENJAMIN HENRY, St. Albans, N.Y. (Age 42) (Claims RCA 8.3 RCM 7.3) 1939 to date Superv. Engr., American Surety Co., New York City; previously Master Mechanic and Mech. Engr. with Arthur Johnson, Inc., Bronx, N.Y.; with WPA, New York City as Plant Engr., and Supt.; Constr. Engr., as Consultant, Tionesta (Pa.) Tunnel; Plant Engr., Dravo Corporation, Pittsburgh, Pa.

FAISANT, JOSEPH LEON, Baltimore, Md. (Age 38) (Claims RCA 9.2 RCM 4.0) March 1925 to Aug. 1935 and Nov. 1938 to date Engr. with Van R. P. Saxe, Cons. Engr.; in the interim Clerk of Works, Board of Public Works, State of Maryland; Field Engr., H. A. Brassert & Co., Engrs. and Contrs., Chicago, Ill.

FENNER, LEWIS EDWIN, Manitowoc, Wis. (Age 35) (Claims RCA 2.8 RCM 9.2) Feb. 1931 to date County Highway Engr., Manitowoc County, Wis.

FLANAGAN, JEFF E., Albuquerque, N.Mex. (Age 31) (Claims RCA 2.5) July 1938 to date with Bureau of Agricultural Economics as Jun. Engr., Jun. Hydr. Engr., and (since May 1939) Asst. Hydr. Engr.; previously with RA as Senior Engr. Aide, Project Engr., Jun. Economist-Engr., and Jun. Engr. (Irrigation); County Engr., WPA; Office Engr., Public Health Service; Project Engr., Mora County (N.Mex.) ERA.

GOWDY, JOSEPH SCOTT (Junior), Denver, Colo. (Age 32) (Claims RCA 2.0) Jan. 1935 to date Sales Engr., Thompson Mfg. Co.; previously Asst. Supt., New Mexico Constr. Co., Albuquerque, N.Mex.

HALL, NORMAN HENRY (Junior), Des Moines, Iowa. (Age 32) (Claims RCA 4.7) July 1935 to date Asst. Engr., Iowa State Conservation Comm.

HARTMAN, PAUL (Junior), New York City. (Age 29) (Claims RCA 1.2) Sept. 1936 to date Tutor, School of Technology, Coll. of City of New York; also, May 1938 to Feb. 1940 Jun. Civ. Service Engr. (Civ. Engr.), Municipal Civil Service Comm., New York City; Research Asst., Columbia Univ.; with WPA, New York City as Asst. Engr., Senior Engr., and Chf., Complaint Checking Unit, Eng. Dept.

HOLLWEG, RALPH, Flushing, N.Y. (Age 36) (Claims RCA 8.0) 1927 to date with New York State Highway Dept., as Chf. of Party on surveys, Inspector and Asst. on concrete road and bridge work, and (since 1932) Engr.-in-Chg.

JANSSEN, ALLEN SHEELEY (Junior), Moscow, Idaho. (Age 32) (Claims RCA 3.3 RCM 0.8) Sept. 1931 to July 1939 Instructor in, and July 1939 to date Asst. Prof. of, Civ. Eng., Univ. of Idaho.

JOHNSON, CECIL WILLIAM (Junior), Denver, Colo. (Age 32) (Claims RCA 3.0) 1934 to date Jun. Engr. and Asst. Engr., U.S. Bureau of Reclamation; previously Inspector, City of Seattle Eng. Dept.

JOVENE, NICHOLAS ANGELO (Junior), Brooklyn, N.Y. (Age 32) (Claims RCA 5.8 RCM 3.4) Dec. 1934 to date Res. Engr. Inspector, FWA, PWA; at present Res. Engr., being Asst. to Superv. Engr.

KIRVEN, JACK BROADNAX, Dallas, Tex. (Age 32) (Claims RCA 2.5 RCM 3.0) 1931 to date with City of University Park as Asst. City Engr., Bldg. and Elec. Inspector, and (since 1937) City Engr.

LEACH, WILLIAM OSLER, Coleman, Tex. (Age 34) (Claims RCA 4.6 RCM 2.0) Nov. 1939 to date Engr. (private practice); previously with Texas State Highway Dept., as Asst. Office Engr., Inspector, Instrumentman, Asst. Res. Engr., and Jun. Res. Engr.

MENDELL, DAN, JR. (Junior), Houston, Tex. (Age 32) (Claims RCA 3.7 RCM 1.7) July 1929 to Feb. 1930 and June 1930 to date with Humble Oil & Refining Co. as Instrumentman, Student Engr., Dist. Civ. Engr., and (since Sept. 1939) Civ. Engr.

MOORE, PAUL LEHMANN GLENN, Selfridge Field, Mich. (Age 34) (Claims RCA 1.2) March 1938 to date with U.S. Army, as Flying Cadet, Air Corps, and (since Feb. 1939) 2d Lieut. Air Reserve; previously Draftsman, Designer, and Estimator, United States Gypsum Co., Chicago, Ill.

MUNSON, WENDELL CURTIS, Lincoln, Nebr. (Age 34) (Claims RCA 7.2 RCM 3.6) Sept. 1934 to date with U.S. Engr. Reserves as 1st Lieut. and (at present) Capt.; since Sept. 1938 Asst. Hydr. Engr., U.S. Bureau of Agri. Economics, Water Utilization Unit.

NEBS, LOUIS AUGUST (Junior), Cincinnati, Ohio. (Age 32) (Claims RCA 3.2) Aug. 1935 to date with Hydr. Sec., U.S. Engr. Office as Jun. Engr., and Asst. Engr.

NUTTER, BEN EARL (Junior), Los Angeles, Calif. (Age 29) (Claims RCA 3.9) June 1938 to date Engr. (Principal), Concrete Products Div., Graham Bros., Inc.; previously Laboratory Asst., Metropolitan Water Dist. of Southern California.

PILCHER, RICHARD LLOYD, Alexandria, Va. (Age 34) (Claims RCA 1.4 RCM 2.6) Sept. 1927 to Sept. 1928, July 1929 to March 1930 and March 1935 to date with U.S. Engr. Office as Inspector, 2d Lieut., Engrs., Constr. Supervisor, Supt. (under Gayle McFadden), and (since Aug. 1939) Asst. Engr., Washington, D.C.

RADLEY, HARMON MONROE, Washington, D.C. (Age 39) (Claims RCA 7.0 RCM 8.0) 1926 to date with Treasury Dept., Public Buildings Administration as Asst. Archt. Engr., and (since Feb. 1935) Office Engr., Grade P-4.

RALSTON, HARRY JAMES (Junior), Tenafly, N.J. (Age 32) (Claims RCA 7.4) Sept. 1937 to date Asst. Engr. with Elson T. Killam, New York City; previously Asst. Engr., Township of Millburn, N.J.; Eng. Asst. with Alexander Potter, New York City.

REICKERT, FREDERICK ARTHUR (Junior), Chicago, Ill. (Age 32) (Claims RCA 3.3) Feb. 1940 to date Designer with Hazelet & Erdal, Cons. Engrs.; previously graduate student and Instructor, Eng. Camp, Yale Univ.; with Montana State Highway Dept., Niagara Steel Finishing Co., Niagara Falls, N.Y., and (Sept. 1933 to Jan. 1936) 2d Lieut., Engr. Reserve Corps., U.S. Army.

RIVER, ROBERT BRAUDON, Los Angeles, Calif. (Age 33) (Claims RCA 3.7) Jan. 1940 to date Jun. Civ. Engr., Los Angeles Dist., U.S. Engr. Dept.; previously with California Div. of Highways as Senior Eng. Field Aide, and Jun. Highway Engr.; Jun. Highway Engr., Region 5, U.S. Forest Service.

ROMINIECKI, ANDREW JOSEPH (Junior), Philadelphia, Pa. (Age 32) (Claims RCA 3.9 RCM 0.7) July 1939 to date Asst. Engr., Sun Oil Co. previously Draftsman, Fluor Corporation, Ltd.; Inspector and Asst. Production Mgr., Welding Engrs., Inc.; Draftsman and Inspector, Warner Co.; Field Engr., Supervisor and Inspector, U.S. Navy Yard.

SCHROEDER, CHARLES WILLIAM EMIL (Junior), Jackson Heights, N.Y. (Age 32) (Claims RCA 11.5) Nov. 1929 to date with Transit Comm., New York City as Junior Engr., Asst. R.R. Engr., and since Jan. 1938 Asst. Civ. Engr. (Bridges and Grade Separations).

SCHULTZ, ERNEST RICHARD (Junior), Denver, Colo. (Age 32) (Claims RCA 3.9) Oct. 1930 to date with U.S. Bureau of Reclamation as Jun. Engr., Asst. Engr., and (since Dec. 1939) Associate Engr.

SHEPHERD, RICHARD BUTLER HOOKE, Memphis, Tenn. (Age 35) (Claims RCA 3.5 RCM 4.7) May 1928 to date with U.S. Engr. Office as Inspector, Jun. Civ. Engr., and (since June 1939) Asst. Engr.

SPAULDING, JOHN NORMAN, San Francisco, Calif. (Age 36) (Claims RCA 11.7) Sept. 1930 to date with Pacific Gas & Elec. Co., as Hydrographer, and (since Sept. 1936) Asst. Engr., Gen. Constr. Dept.

STALFORT, HENRY ALFRED, Baltimore, Md. (Age 27) (Claims RCA 2.8 RCM 3.0) Feb. 1934 to date with Consolidated Eng. Co., Inc., as Asst. Supt., Estimator, Designing Engr., and (since Nov. 1934) Project Mgr.

STANLEY, HOWARD BURTON (Junior), Portland, Ore. (Age 32) (Claims RCA 2.0) June to Dec. 1933 and March 1934 to date with U.S. Bureau of Public Roads (PRA) as Rodman, Chainman, and (since May 1934) Jun. Highway Engr.

STEBBINS, WILLIAM ALFRED, Montpelier, Vt. (Age 28) (Claims RCA 3.8) Sept. 1935 to May 1936 Draftsman and Aug. 1938 to date Designing Engr., Vermont State Highway Dept., Bridge Div., in the interim Gen. Engr. for E. C. Hayden and E. C. Hayden Estate, Barre, Vt.; Timekeeper, Engr., and Supt. Troy Paving Co., Hudson Falls, N.Y.

STURGES, FRANK CALEB, Library, Pa. (Age 30) (Claims RCA 6.0 RCM 1.5) June 1931 to date with Pennsylvania Drilling Co., Pittsburgh, Pa., as Field Supt., and (since Sept. 1935) Asst. Engr.

TEMPLETON, ALEXANDER SHANNON, Dallas, Tex. (Age 36) (Claims RCA 9.3) Nov. 1938 to date Engr.-Inspector, PWA; previously Engr.-Inspector, Div. of Light & Water, Memphis, Tenn.; Office Engr., RA, Pauls Valley, Okla.; Area Engr., NYA, Fort Worth, Tex.; Engr.-Inspector, Texas State Highway Dept.; Supt., WPA, Dallas.

WAGNER, RICHARD CARL (Junior), Lebanon, Ind. (Age 32) (Claims RCA 10.2) June 1929 to date with Indiana State Highway Comm., Bridge Dept. as Eng. Asst., Project Bridge Engr., Asst. to Dist. Engr. of Bridge Constr., and (since Nov. 1936) Office Engr. of Bridge Constr.

WALLACE, JAMES NICHOLAS, Huntington, W.Va. (Age 33) (Claims RCA 2.0 RCM 7.0) Sept. 1925 to Sept. 1926, April 1931 to March 1933 and Dec. 1933 to date with State Road Comm. of West Virginia as Rodman, Instrumentman, Jun. Engr., and (since Jan. 1940) Senior Maintenance Engr., Dist. 2.

WHINNERAH, RICHARD WALTER (Junior), Denver, Colo. (Age 32) (Claims RCA 5.0) June 1929 to date with U.S. Bureau of Reclamation as Jun., Asst. and Associate Engr.

WHIPPLE, WILLIAM, JR., Omaha, Nebr. (Age 31) (Claims RCA 1.7 RCM 2.2) Aug. 1933 to date with Corps. of Engrs., U.S. Army, at present as 1st Lieut.

WHISLER, BENJAMIN ADSIT, Ames, Iowa. (Age 30) (Claims RC 2.5) Jan. 1931 to June 1932 Graduate Asst., and Sept. 1936 to date Instructor, Iowa State Coll.; in the interim Research Asst., Iowa Eng. Experiment Station.

WOOD, GARDNER KENNETH, Boston, Mass (Age 34) (Claims RCA 9.4) June 1928 to date with U.S. Geological Survey as Jun. Engr., Asst. Engr., and (since March 1940) Associate Engr.

WOOD, ROBERT LEO, Vincennes, Ind. (Age 34) (Claims RCA 10.9) June 1929 to date Project Engr., Bridge Dept., Indiana State Highway Comm.

WOODBRIDGE, EDWIN WILSON, Omaha, Nebr. (Age 52) (Claims RCA 21.5) Aug. 1908 to date with City Engr.'s Office, Omaha, Nebr., in various positions, at present as City Engr.

APPLYING FOR JUNIOR

CHARLESON, DONALD MCKAY, JR., Seattle, Wash. (Age 26) 1940 B.S. in Civ. Eng., Univ. of Wash.

COLLIE, ROBERT MONROE, Austin, Tex. (Age 24) (Claims RCA 1.0) 1938 B.S. in C.E., Agri. & Mech. Coll. of Tex.; July 1938 to date with Lower Colorado River Authority.

COMPTON, ROBERT HAYES, Paradise, Calif. (Age 29) 1937 A.B. in Eng., and 1940 C.E., Stanford Univ.

CRANE, RALPH AMZI, Wayne, Pa. (Age 26) 1937 B.S. in C.E., Univ. of Pa.; Feb. 1939 to date Expeditor, The Midvale Co., Philadelphia, Pa.

CUNNINGHAM, LUKE ALEXANDER, Seattle, Wash. (Age 22) 1940 B.S. in Civ. Eng., Univ. of Wash.

DEAN, RALPH GORDON, Salt Lake City, Utah. (Age 24) 1940 B.S. in Civ. Eng., Univ. of Utah.

DEIBLE, HENRY BOWSER, Pittsburgh, Pa. (Age 30) Oct. 1937 to date with Pittsburgh and Lake Erie R.R., as Chainman and (since June 1939) Rodman; previously Jun. Constr. Inspector and Senior Constr. Inspector, Pennsylvania Dept. of Highways.

FAGRE, STANLEY CHARLES, Estherville, Iowa. (Age 23) 1940 B.S. in C.E., Iowa State Coll.

FEJER, ANDREW, Pasadena, Calif. (Age 27) 1936 Mech. Engr., Tech. Univ. of Prague; 1939 B.S. in Aeronautics, Calif. Inst. Tech.; Sept. 1938 to date at California Inst. of Technology as graduate student and (since July 1939) Research Asst., Hydr. Machinery Laboratory.

FRIEDLANDER, ARNOLD, New York City. (Age 21) 1940 B.C.E., Coll. of City of New York.

GURGONE, SANTO HENRY, New York City. (Age 28) (Claims RCA 1.1) Oct. 1934 to date with WPA as Instrumentman, and (since April 1939) Jun. Engr.

HENRICKSEN, ARTHUR MONROE, JR., Brooklyn, N.Y. (Age 25) (Claims RC 3.3) April 1937 to date with Madigan-Hyland, Cons. Engrs., Long Island City, N.Y., as Instrumentman, Chf. of Party, and Asst. Res. Engr.; previously with Frederick Snare Corporation, Gen. Contrs., New York City.

HIGGINS, JOSEPH MELCHIADES, Revere, Mass. (Age 23) 1939 B.S. in Civ. Eng., Northeastern Univ.; Aug. 1939 to date Field Engr., Silas Mason Co.

HODGES, BEVERLY WAUGH, Seattle, Wash. (Age 22) 1940 B.S. in Civ. Eng., Univ. of Wash.

HURLEY, HENRY WRIGHT, Cambridge, Mass. (Age 28) July 1936 to date Lieut., Corps of Engrs., U.S. Army; previously Chf. of Party, U.S. Bureau of Land Reclamation: Instrumentman and Chf. of Party, U.S. Bureau of Public Lands.

KISDUCAK, FRANK STEVE, Seattle, Wash. (Age 28) 1940 B.S. in Civ. Eng., Univ. of Wash.; March 1940 to date Senior Civ. Eng. Aide, Seattle Transit System.

LANCASTER, DALE MARION, Denver, Colo. (Age 29) (Claims RCA 1.4) Dec. 1934 to date with Bureau of Reclamation as Laboratory Asst., Jun. Engr., and (since Dec. 1939) Asst. Engr.

LEESON, ELWOOD RICHARD, Rolla, Mo. (Age 28) (Claims RCA 2.6) July 1937 to date with U.S. Geological Survey, Water Resources Branch, as Jun. Hydr. Engr., and (since Feb. 1940) Asst. Hydr. Engr.; previously Materials Inspector (Grade A), Kansas State Highway Comm.

LOOLI, ALBERT JOSEPH, Danville, Ill. (Age 23) 1940 B.S. in C. E., Univ. of Ill.

MITCHELL, WILLIAM HENRY, Providence, R.I. (Age 25) (Claims RCA 0.8) April 1939 to date Draftsman, War Dept., U.S. Engrs.; previously Jun. Civ. Engr., Bureau of Yards & Docks, Navy Dept., Boston Navy Yard; Town Engr., Wakefield, Mass.; Jun. Engr. (Instrumentman), Metropolitan Dist. Comm.; Rodman and Chf. of Party, New Haven R.R.

PAPANEK, MAXWELL CHARLES, Lawrence, N.Y. (Age 21) 1940 B.C.E., Coll. of the City of New York; Feb. 1940 to date Engr. with Gibs & Cox, Inc., Naval Archts.

RIEBEN, THORBURN REES, Huntington Park, Calif. (Age 24) 1938 A.B. in Eng., and 1940 C.E., Stanford Univ.

ROBERSON, CECIL THOMAS, Mays Lick, Ky. (Age 26) March 1939 to April 1940 Jun. Engr. Inspector, PWA, and (since April 1940) Engr. with Modjeski and Masters; previously Sub-Inspector, War Dept.; Farm Supervisor, AAA; Draftsman, Timekeeper, and Business Mgr., H. H. Robertson Co.

ROSE, ELLSWORTH LOUIS, Cerro de Pasco, Peru. (Age 27) June 1936 to date Structural Draftsman successively with Fort Pitt Bridge Works, Cannonsburg, Pa., American Bridge Co., Ambridge, Pa., Tunnel Design Div., Pennsylvania Turnpike Comm., Harrisburg, Pa., and since Feb. 1940 with Cerro de Pasco (Peru) Copper Corporation.

SCHAFER, ANDREW GEORGE, Huntington, W.Va. (Age 22) 1939 B.C.E., Brooklyn Pol. Inst.; Oct. 1939 to date Student Engr. (Civ.), U.S. Engrs.

SCOFIELD, WALTER FLEMING, Houston, Tex. (Age 29) (Claims RCA 1.3) 1938 B.S. in Civ. Eng., Univ. of Kans.; Sept. 1939 to date Instructor in Civ. Eng., The Rice Inst.; previously Asst. Res. Engr., Black & Veatch, Cons. Engrs., Kansas City, Mo.

SHEPARD, ROBERT EASTON, Snoqualmie Falls, Wash. (Age 28) 1940 B.S. in Civ. Eng., Univ. of Wash.

SPEARS, RALPH WESTLY, Belle Plaine, Kans. (Age 28) May 1938 to date with U.S. Engrs., Kansas City (Mo.) Dist., as Inspector, Jun. Engr. (Hydr.), and since June 1939 Inspector (Gen. Const.), River Constr. Sec.; previously Transitman, Sumner County (Kans.) Eng. Dept.

STRAUS, HOWARD, Newark, N.J. (Age 23) 1939 M.E., Stevens Inst. Tech.; March 1940 to date Instrumentman, Straus Constr. Co.; previously Draftsman, Crucible Steel Co. of America, Harrison, N.J.

WERDEN, HARMER ALLEN, Lewisburg, Pa. (Age 22) 1938 C.E., Cornell Univ.; Feb. 1939 to date Instructor in Civ. Eng., Bucknell Univ.

WILCOX, WILLA RUTH (Miss), Seattle, Wash. (Age 23) 1940 B.S. in Civ. Eng., Univ. of Wash.

WOOLHISER, ROY ELLIS, Germfask, Mich. (Age 26) (Claims RCA 2.0) March 1936 to date with U.S. Govt., as Student Engr., Bureau of Public Roads, Eng. Aide, Bureau of Agri. Eng., and (since June 1938) Asst. Civ. Engr., Bureau of Biological Survey; previously County Surveyor, Tripp County Road Comm.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 132 of the 1940 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N. Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CONSTRUCTION ENGINEER; Assoc. M. Am. Soc. C.E.; 35; married; 10 years with contractor on concrete dams, power plants, flood control, bridges, buildings; experienced reinforced concrete construction, excavations, structural steel, equipment maintenance, hydraulic machinery installation; 2 years paving experience; 5 years soil, moisture control. Employed; available on reasonable notice; wishes position with contractor or engineering firm. C-703.

CIVIL ENGINEER; M. Am. Soc. C.E.; registered; 35 years experience in general engineering including water works, sewers, paving, railways, industrial plants, hydroelectric plants, transmission lines; location, construction, maintenance, valuations, appraisals, etc. Foreign experience in West Indies and South America, and War-time construction in France. Available now, preferably in United States. C-706.

CIVIL ENGINEER; Assoc. M. Soc. C.E.; 36; graduate; registered in Pennsylvania; superintendent and manager in charge of estimating and construction of roads, bridges, and heavy excavation. Desires permanent connection with contractor or consulting engineer; location immaterial. C-709.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 39; technical graduate; registered, state of Colorado. Wide experience in tunnel construction, rolled earth-fill dams, concrete dams, canals and waterways, administration, investigations, reports, and estimates. Municipal and general engineering fields. Wishes position with engineer, architect, or contractor. C-714.

EXECUTIVE

ENGINEER-EXECUTIVE; M. Am. Soc. C.E.; 51; married; B.S. in C.E.; 30 years experience; last 14 years in Buenos Aires—vice-president in responsible charge of large contracting company's branch operating over South America; fluent Spanish and thorough knowledge of business and financial conditions and commercial practices in use throughout Argentina, Chile, and Venzuela. C-700.

CIVIL ENGINEER; M. Am. Soc. C.E.; Rensselaer graduate; licensed; 31 years experience in harbor work of all kinds; industrial plants; bridges; refineries; cold storage; power plants; planning, layout, design, and supervision. Will go anywhere, preferably Northwest. Prefer position with consulting engineer. C-701.

CIVIL ENGINEER; M. Am. Soc. C.E.; technical graduate; licensed; 30 years experience in design, construction, administration. Special experience on bridges, general municipal work, and public relations. C-707.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; B.S.C.E. (Summa cum lauda), Syracuse University, 1939; M.S.C.E., University of Illinois, 1940; Tau Beta Pi, Sigma Xi; specialized in aerial photogrammetry at Syracuse, structural engineering and theory of elasticity at Illinois; three months experience as structural steel detailer. Available June 1940. C-702.

PLANT CIVIL ENGINEER; Jun. Am. Soc. C.E. 27; married; graduate C.E.; registered professional engineer and surveyor, Ohio; 3 years assistant, 10 months chief civil engineer for large industrial plant; 8 months resident engineer in charge of construction of new building; estimating, design, layout, job control, maintenance of building and grounds. C-705.

CIVIL ENGINEER; Student Chapter member; 23; single; B.S.C.E. and B.S. in commercial engineering, University of Nebraska, 1940; lieutenant, Corps of Engineers, U.S. Army Reserve; general business experience covering financial, management, and purchasing. Particularly interested in the fields of city planning and municipal engineering; location immaterial. C-710.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; highway research board; 28; married; University of Minnesota training; 3½ years superhighway, parkway design, and construction; one year municipal; 2½ years railroad and heavy construction. Location immaterial; available immediately. C-711.

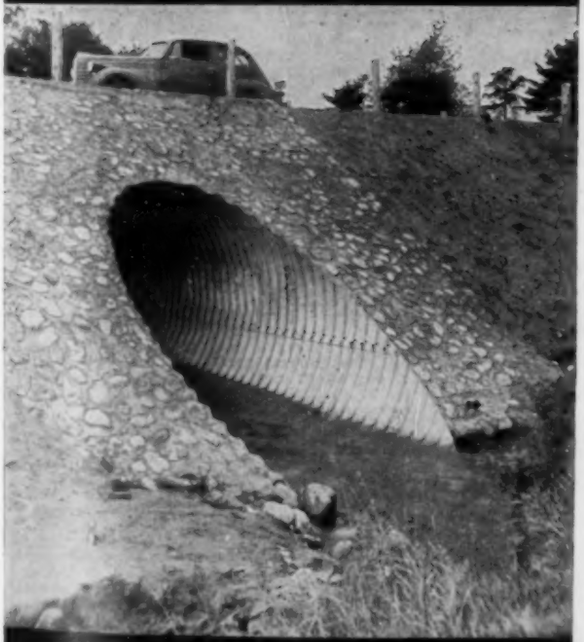
CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; B.S. and M.S. degrees with specialization in structures; one year junior designer in reinforced concrete; 1½ years estimating and 10 months as supervisor for alteration work. Salary secondary to good opportunity. C-715.

TEACHING

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 52; technical graduate; 34 years experience in

The increased weight and speed of modern vehicles made this structure obsolete. Maintenance was an expensive problem because the plank flooring had to be replaced at frequent intervals.

Placement of a timber mat for bearing surface and erection of the Multi Plate units was done in winter without difficulty. Local unskilled labor using only hand tools completed the job in three weeks.



The new structure is situated upstream from the old bridge site. Three feet of fill covers the pipe and the slope is protected against erosion by a rip-rap headwall. The pipe was beveled to fit the slope for better appearance and hydraulic efficiency.

BRIDGE DOLLARS GO FARTHER

when you use Multi Plate

Limited funds need not stop you from replacing unsafe or inadequate bridges. Here's one example where the job was done with ARMCO Multi Plate at an estimated saving of 45 per cent over competitive material.

In this case relocation of the road, and the fact that the old structure was inadequate, dictated immediate construction. Unstable foundation conditions added to the problem. The solution, after making a bearing test, was an ARMCO Pipe on a timber mat. The 105-inch diameter pipe is 60 feet long and makes a sturdy, permanent installation that will last for years without maintenance.

You too can reduce costs and speed construction of large drainage openings by using ARMCO Multi Plate Pipe or Arches. Write us for complete information and prices. Armco Drainage Products Association, 501 Curtis Street, Middletown, Ohio.

MULTI ARMCO PLATE

ARMCO MULTI PLATE

A TYPE OF PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

highways, design, and construction as well as 11 years as an executive and chief engineer; desires position as teacher in highway engineering in some university or a position as city manager for city with population of 50,000 or under. C-704.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 33; B.S. in C.E.; M.S. (geology); licensed professional engineer and land surveyor; 12 years professional experience in analysis, design, construction, administration; concurrent teaching experience in civil engineering department, evening division, Metropolitan university; seeks position as engineer or assistant professor. C-708.

STRUCTURAL-MECHANICAL ENGINEER; Jun. Am. Soc. C.E.; 26; B.S. "with high honors"; M.S., Cornell University, specializing in hydraulics and structural engineering; 2 years experience in structural design, including industrial buildings, highway bridges oil refinery stills, etc.; 1½ years experience in machine design. Desires position as instructor in college or university. C-712.

ASSISTANT PROFESSOR; Jun. Am. Soc. C.E.; 31; B.S.; M.S.C.E.; C.E.; 10 years teaching varied program including practically every civil engineering subject; 2¼ years practical experience in surveying, construction, highways, drafting; some minor publications. C-713.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 122 of the Year Book for 1940. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

AMERICAN PLANNING AND CIVIC ANNUAL. Edited by H. James. Washington (D.C.), American Planning and Civic Association, 1939. 288 pp., illus., 9 × 6 in., cloth, $3.

The papers included in this volume have been presented at various national and regional conferences, and are grouped under the headings of community reclamation, industrial migration, man-made obstacles to planning, rural problems, national income, public works, and state and national parks. They constitute a survey of current work in these fields, leading toward the improvement of living and working conditions.

BUSINESS METHODS IN THE BUILDING FIELD. By G. Schobinger and A. M. Lackey. New York, McGraw-Hill Book Co., 1940. 350 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $3.50.

This practical manual of business methods and documentary procedure in the development and execution of industrial, power, and building projects analyzes the administrative functions of the work against the background of the contract responsibilities involved, and outlines methods for the production of competent documents for use in performing these functions. A check list and specimen forms are given for a complete building project.

DEPRECIATION OF PUBLIC UTILITY PROPERTY. A Collection of Papers by Maurice R. Scharff, Franklin J. Leerburger, and Joseph Jeming. New York, Maurice R. Scharff (285 Madison Avenue), 1940. 225 pp., diagrs., charts, tables, 9 × 6 in., cloth, $3.

This volume includes papers on the interdependence of annual and accrued depreciation in regulation of public utility corporations; depreciation accounting problems; depreciation and obsolescence; an asymptotic method of determining annual and accrued depreciation; "straight line depreciation"; and estimated "actual" depreciation of public utility properties.

ÉLASTICITÉ ET PHOTOÉLASTICIMÉTRIE. By H. Le Boiteux and R. Boussard. Preface by M. P. Langevin. Paris, Hermann & Co., 1940. 361 pp., illus., diagrs., charts, tables, 10 × 7 in., paper, 180 frs.

This treatise is the first French work to provide a complete exposition of the photoelastic methods of studying stresses in materials. The first section gives the fundamental mathematical theory of elasticity; the second, the principles of optics involved; the third section discusses photoelastic principles, apparatus, and methods; and the fourth, the determination of stresses by photoelastic studies.

ENGINEERING REORGANIZATION. By J. J. Gillespie, with a foreword by D. Brown. New York, Pitman Publishing Corp., 1940. 268 pp., illus., diagrs., charts, tables, 8½ × 5½ in., cloth, $4.

This book is written for engineering companies not engaged in continuous or mass production. The general subjects of planning, material and quality control, time study and job analysis, costs and sales methods are discussed, together with many specific examples and applications to particular shops and departments.

EROSIONAL TOPOGRAPHY AND EROSION. A Mathematical Treatment. By James M. Little. San Francisco, A. Carlisle and Company (135 Post Street), 1940. 104 pp., diagrs., tables, charts, 9 × 6 in., cloth.

The principal objectives of this treatise (which is lithotone printed) are to tie in erosional geomorphology with hydraulics and hydrology; to develop an erosional rating for turbulent flow and to expand the development for land slope profiles and their surface material of soils and covers, outlining the application to concentrated runoff flow; and to provide sufficient tables for practical application to problems of sheet runoff.

EXPERIMENTAL AERODYNAMICS. By H. C. Pavian. New York and Chicago, Pitman Publishing Corp., 1940. 168 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, $2.50.

This text contains a simple, concise presentation of the elements of wind-tunnel work, in which stress is laid on its applications in air conditioning, streamlining, etc., as well as in aviation. The work is intended as a text and laboratory handbook in technical schools and colleges. In addition to numerous experiments, brief notes on model building and the construction of small wind tunnels are included.

(THE) GEOLOGY OF SOUTH AFRICA, 2 ed. By A. L. du Toit. Edinburgh and London, Oliver and Boyd, Ltd., 1939. 539 pp., illus., diagrs., maps, charts, tables, 9 × 6 in., cloth, 28s.

Since the first edition of this work appeared in 1926 great advance has been made in our knowledge of South African geology, and this revised edition of Dr. du Toit's treatise will be very useful. It follows the general arrangement of its predecessor, but has been largely rewritten and increased in size, and the geological map has been redrawn. An excellent account of the geology of South Africa, including the mineral deposits, is provided, with many fine illustrations.

INTRODUCTION TO THE THEORY OF FUNCTIONS OF A REAL VARIABLE. By S. Verblunsky. Oxford (England), Clarendon Press; New York, Oxford University Press, 1939. 169 pp., tables, 9 × 5½ in., cloth, $4.25.

In order to facilitate the progress of the student, the subject is treated as a body of deductions from specified postulates, and the successive topics are considered in logical order. These topics, in order, are number, sets and functions, convergence, continuity and the derivative, elementary functions, primitives, limits and higher derivatives, integrals, and series. There are many examples with proofs.

(THE) JUNGLE ROUTE. By F. W. Kravigny. New York, Orlin Tremaine Co., 1940. 234 pp., illus., tables, 8½ × 5½ in., cloth, $3.

During 1909 and 1910, the author was a member of an expedition engaged in building a railway from Madeira to Mamoré, in the Brazilian hinterland. His account of his experiences is largely a personal one, dealing with the incidents of jungle life, the difficulties of engineering in the tropics, etc. A bibliography of the railway is given, with extracts from various papers on the project. There are many good photographs.

MANUAL OF WATER QUALITY AND TREATMENT. Prepared and published by the American Water Works Association (22 East 40th St.), New York, 1940. 294 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, $3.

This manual is intended to represent, as adequately as possible, the prevailing views of waterworks managers and specialists concerning the quality and treatment of water supplies. A thorough review of the organisms that occur in water, the methods of removal in use, treatments to remove tastes and odors, and methods of conditioning water chemically are discussed in a practical, up-to-date way. There is a bibliography.

MECHANICS APPLIED TO VIBRATIONS AND BALANCING. By D. L. Thornton. New York, John Wiley & Sons, 1940. 529 pp., illus., diagrs., charts, tables, 10 × 6 in., cloth, $7.50.

The purpose of this book is to present the general theory of vibrations in its various aspects. While written primarily for engineers, it should also be of use to students of physics. The subjects discussed include the balancing of locomotives and engines, the theory of vibrations, the propagation of stress in elastic materials, and vibrations in beams and plates and in rotating shafts and disks. A final chapter gives a general survey of the subject and of its applications to the testing of materials, to ships, bridges, traffic, geophysical surveying, etc.

Great Britain. Dept. of Scientific and Industrial Research. REPORT OF THE ROAD RESEARCH BOARD, with the Report of the Director of Road Research for the Year Ended 31st March 1939. London, His Majesty's Stationery Office, 1939. 172 pp., illus., diagrs., charts, tables, 10 × 6 in., paper, 3s. 6d. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $1.05).

This report summarizes the progress during the year in the investigations undertaken by the Board. Research work included the study of earthworks and road and bridge foundations, road materials and methods of construction, the surface characteristics of roads, and the forces between vehicle and road surface. A list of publications by the Board and its staff during the year is included.

(THE) ROAD TO MODERN SCIENCE. By H. A. Reason. New York and London, D. Appleton-Century Co., 1940. 297 pp., illus., diagrs., charts, tables, 8½ × 5½ in., cloth, $3.

Important scientific achievements from the earliest recorded times to the present day are described in a concise, simple manner. Some account is given of the contemporary background and the lives of the men connected with the various discoveries. A chronological arrangement carries Part I up to the time of Newton. Part II (1600 to date) takes up each science separately, closing with a chapter on modern investigations.

TRAVAUX MARITIMES, Vol. 3. Ouvrages Intérieurs et Outillage des Ports. By G. de Joly, P. H. Watier, Ch. Laroche, and A. de Rouville. Paris, Dunod, 1940. 703 pp., diagrs., charts, maps, tables, 10 × 7 in., paper, 169.95 frs.; bound, 190.55 frs.

This third volume of a series of four on maritime works covers the arrangement and management of harbors; the construction of quays and docks of various types; equipment for building, launching, and maintaining ships; harbor bridges, locks, and sluices; dredging and cargo handling equipment; and the administration of commercial seaports. The treatment is comprehensive and detailed, and there are many illustrations.

TREATISE ON THE LAW OF SURVEYING AND BOUNDARIES, 2 ed. By F. E. Clark. Indianapolis (Ind.), Bobbs-Merrill Co., 1939. 896 pp., illus., diagrs., charts, maps, tables, 8½ × 5 in., leather, $6.

This book sets forth the laws pertaining to surveying and boundaries, and discusses the technical and legal problems that arise in the location and settlement of boundaries. The author writes from experience both as surveyor and lawyer, and treats the subject clearly and practically. A chapter summarizing state laws and decisions has been added to this edition.

(THE) ULTRACENTRIFUGE. By T. Svedberg and K. O. Pedersen, and Others. Oxford (England), Clarendon Press; New York, Oxford University Press, 1940. 478 pp., illus., diagrs., charts, tables, 9½ × 6½ in., cloth, $12.50.

All features of the problem of the ultracentrifuge are discussed at length by various authorities: Its design and construction as an engineering problem in which the material used is stressed to the limit of its strength; the theory of sedimentation; methods of operation; the technique of measurement for recording rates of sedimentation and the steady state ultimately obtained; and the interpretation of results. There is a long bibliography.

Wissenschaftliche Abhandlungen der deutschen Materialprüfungsanstalten, Folge I, Heft 3. WERKSTOFF-PRÜFUNG IM BERGBAU. Berlin, Julius Springer Verlag, 1939. 80 pp., illus., diagrs., charts, tables, 12 × 8 in., paper, 16.80 rm.

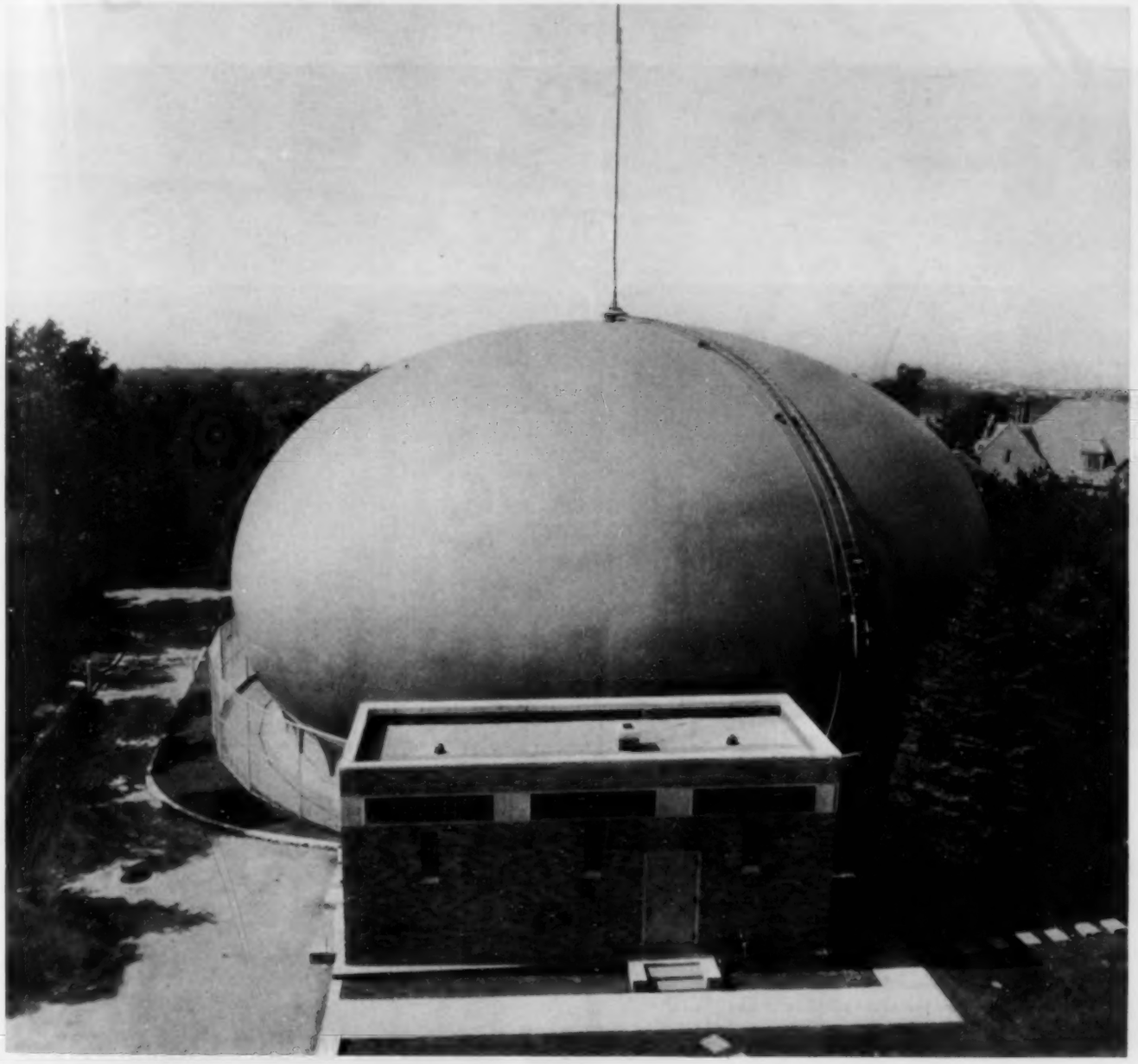
This publication describes the work of the National Testing Laboratory in the field of mining. Among the problems discussed are the prevention of mine fires, preservation of mine timber, testing mine masonry and concrete, rope testing, the investigation of earth pressures, etc.

WRITING THE TECHNICAL REPORT. By J. R. Nelson. New York and London, McGraw-Hill Book Co., 1940. 373 pp., diagrs., tables, 9½ × 6 in., cloth, $2.50.

The technical report is regarded as a structure designed to meet certain definite requirements. Fundamental considerations which bear on the design and composition of a report are reviewed. Specific directions are given for the setup of the report, with several annotated illustrative reports. A systematic procedure is outlined for the critical examination of reports, including some typical cases, and suggestions are made with regard to classroom procedure. The result is an unusually helpful book.

ZONING, the Laws, Administration, and Court Decisions During the First Twenty Years. By E. M. Bassett. New York, Russell Sage Foundation, 1940. 275 pp., 9½ × 6 in., cloth, $3.

The work of an attorney of wide experience with zoning problems, this book discusses the origins of zoning, its legal development and present status. Its review of court decisions upon many problems that arise is a valuable contribution to the literature. This edition contains fuller citations than the previous one and some clarifications and extensions.



SPHEROIDAL Tank for Water Storage

The City of Brookline, Mass., desired to increase the capacity of the storage facilities in its high service mains. The logical location for this storage is on Marked Tree hill.

The lot on which the storage is located has restrictions as to the height of the structure that could be built there. The water department wanted 1,000,000 gals. of storage in a range of 25 feet just within that limit. The public demanded a pleasing looking structure.

The 1,660,000-gal. Spheroid shown above was suggested, and later installed, to meet all these requirements. Its general shape is interesting. The final coat of paint is grey to blend into the sky. Extensive plantings give the site a park-like appearance.

Structurally, the Brookline Spheroid is of sound design. It is similar to the smooth type Hortonspheroid, hundreds of which are used in the oil industry to store volatile petroleum products.

We build special designs of all types to meet unusual requirements. Whenever contemplating the installation of storage facilities or steel plate work of any kind, write our nearest office.

CHICAGO BRIDGE & IRON COMPANY

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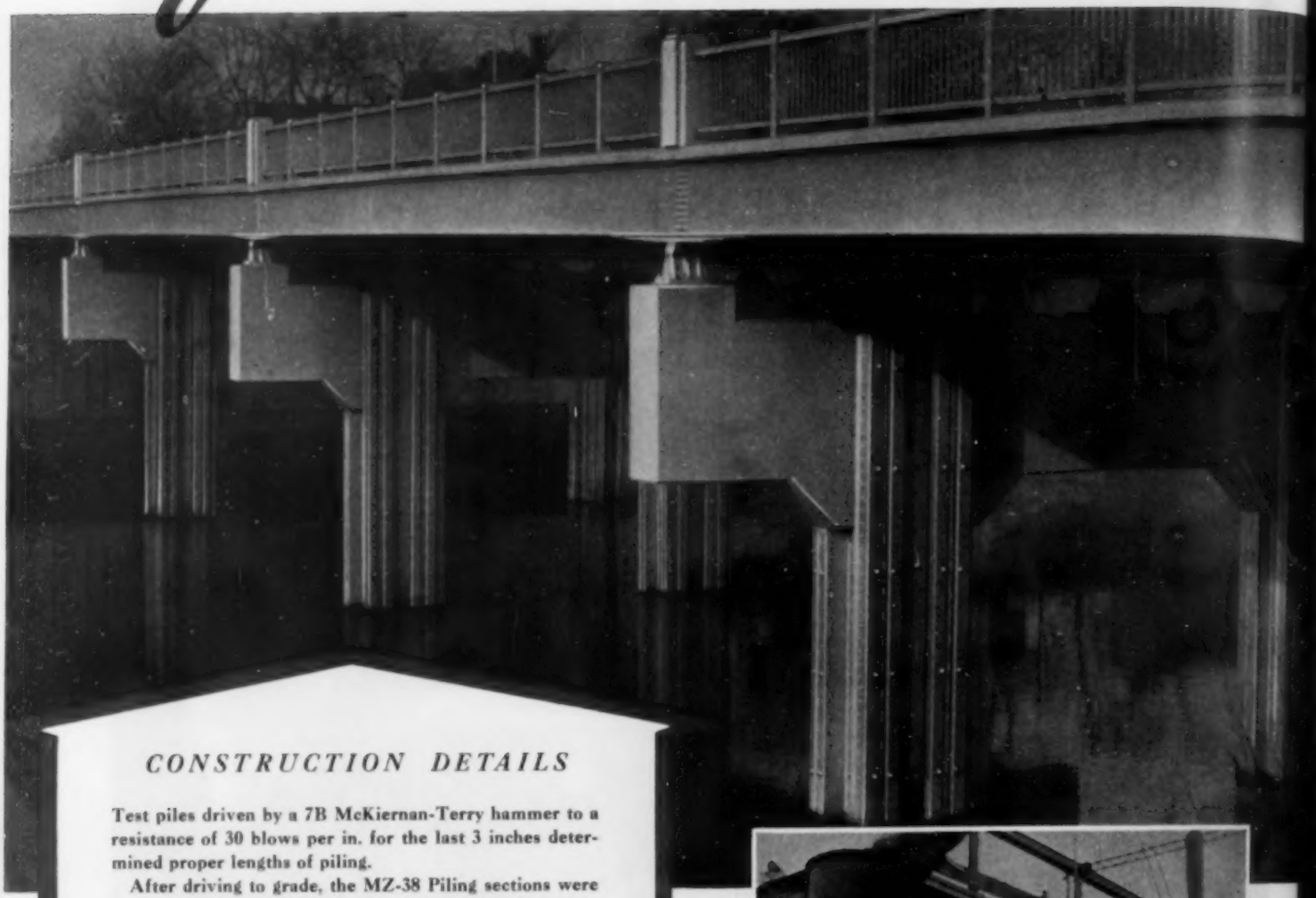
Detroit.....1541 LaFayette Bldg.
Cleveland.....2263 Rockefeller Bldg.
New York.....3395—165 Broadway Bldg.
Boston.....1545 Consolidated Gas Bldg.
Philadelphia.....1652-1700 Walnut Street
Dallas.....1485 Liberty Bank Bldg.
Houston.....2919 Main Street
Tulsa.....1647 Hunt Bldg.
Birmingham.....1596 N. 50th Street
San Francisco.....1084 Rialto Bldg.
Los Angeles.....1456 Wm. Fox Bldg.

Plants in BIRMINGHAM, CHICAGO, and GREENVILLE, PENNA. In Canada—HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

again .. MZ-38 Piling in

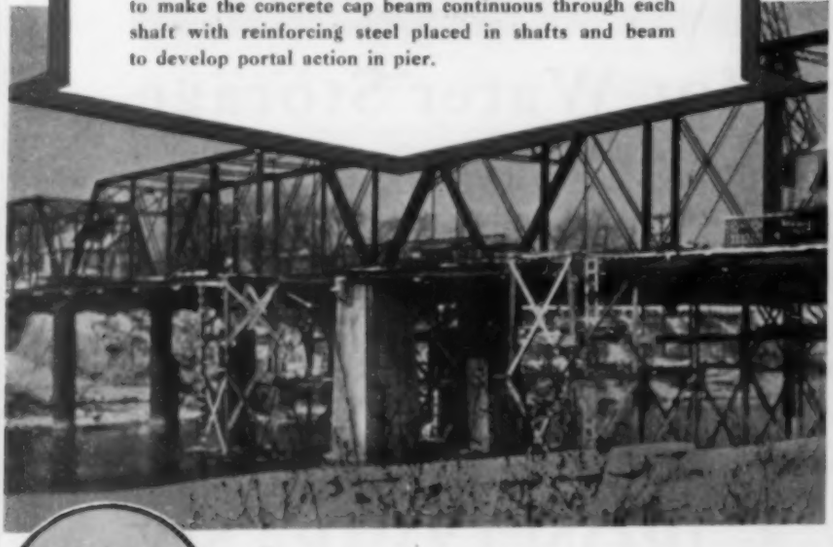


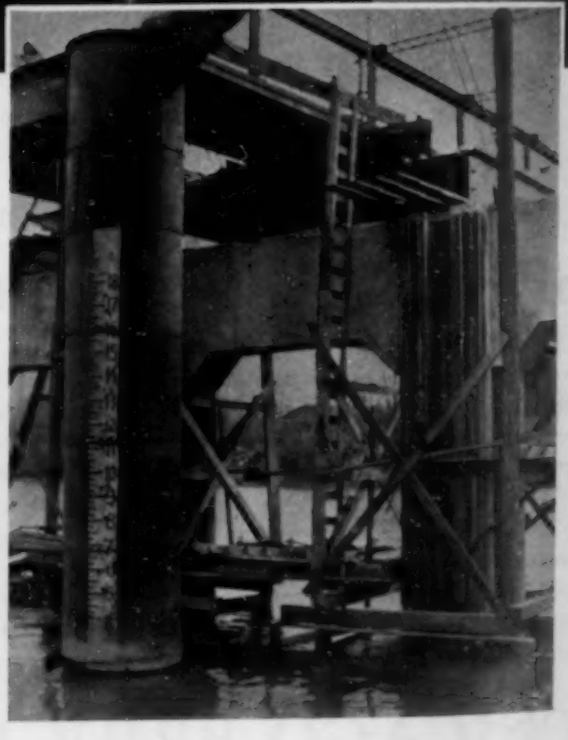
CONSTRUCTION DETAILS

Test piles driven by a 7B McKiernan-Terry hammer to a resistance of 30 blows per in. for the last 3 inches determined proper lengths of piling.

After driving to grade, the MZ-38 Piling sections were welded together at the interlock—a 3-in. bead every 12-in. —for a distance of 8 ft. down from piling top.

By stopping the top elevation of the two side sections in each pier, 8-ft. below the other sections, it was possible to make the concrete cap beam continuous through each shaft with reinforcing steel placed in shafts and beam to develop portal action in pier.





USS

U·S·S STEEL SHEET PILING

UNITED STATES STEEL

in novel Bridge Pier Construction

– combines minimum pier load with high strength
– provides maximum scour protection
– assures rapid erection and low cost

ORIGINALLY this bridge at Dover, Ohio, on the heavily traveled Highway Routes 8, 250 and 21, was carried over the Tuscarawas River on a 3-truss span supported on steel shell cylinder piers. Erected in 1893, its 18-ft. roadway created a traffic bottleneck and its light construction was dangerously over-stressed by heavy trucks and trailers carrying steel and coal.

When a new bridge was contemplated, the engineers decided upon a construction incorporating U·S·S MZ-Steel Sheet Piling pier shafts supporting a 4-span continuous rolled CB structural-steel deck, with a 42-ft. roadway of U·S·S I-Beam-Lok Armored Flooring, and two 8-ft. sidewalks of T-Tri-Lok, all designed to meet Ohio State Highway live load specifications. This design was estimated by contractors to be 20% cheaper than the conventional type of bridge and pier. Diagram below fully details the unusual pier construction.

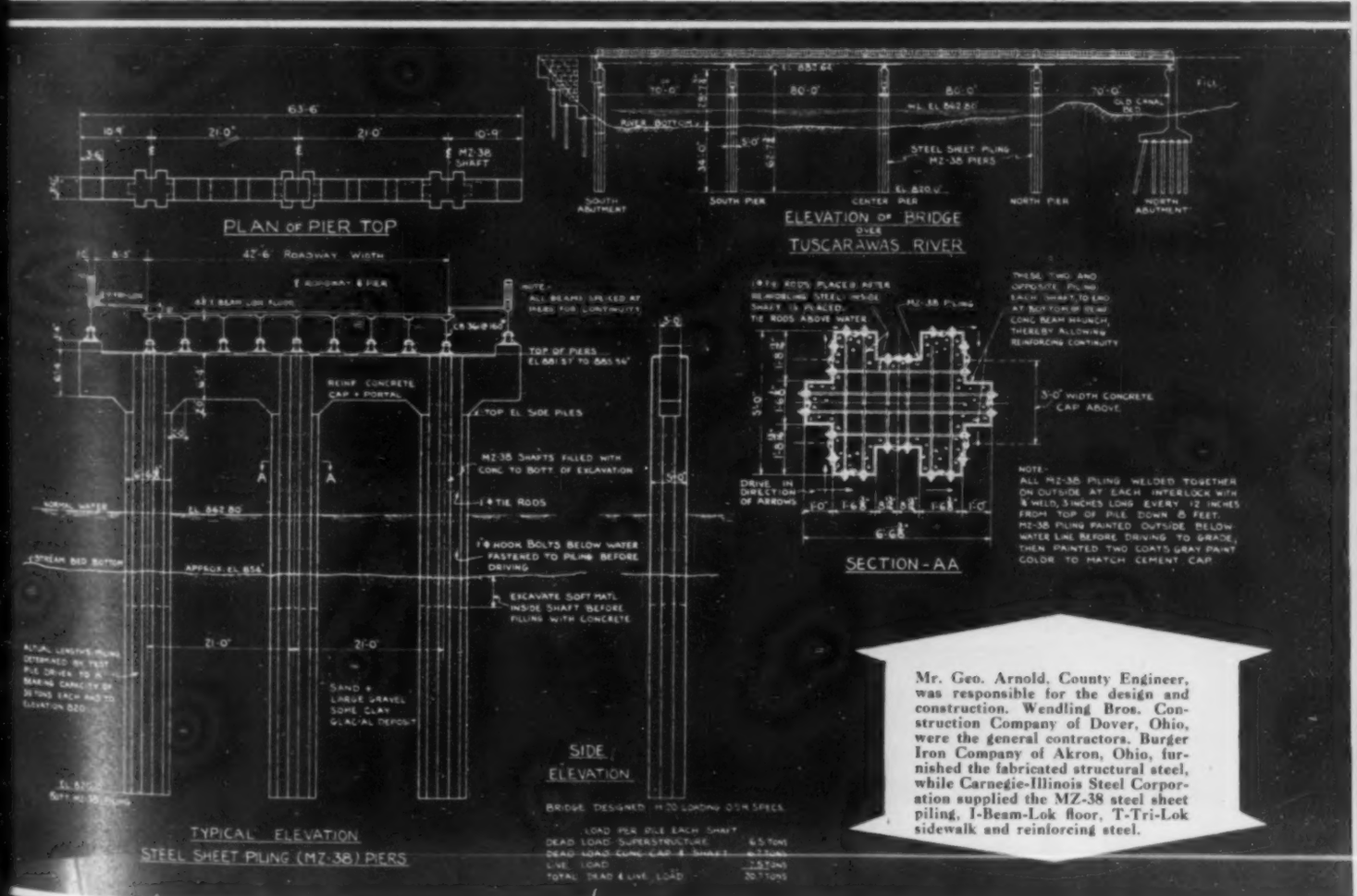
Each of the three piers and the south abutment are built of three shafts made up of 8 pieces of MZ-38 Steel Sheet Piling (copper-bearing) and 4 pre-fabricated corners—63 to 65 ft. long—driven at least 34 ft. into the river bottom and/or to 30-ton bearing capacity. Penetration provides for 10-ft. of scour, leaves 24 ft. penetration to develop the required maximum of 20 tons per pile. Hook bolts located between waterline and shaft bottom, are fastened to inside face of each piece of piling before driving. These, and the cross-tie rods above the waterline securely anchor concrete fill to the sheet piling. All loads are thus transmitted to the piling and both concrete fill and piling act as a unit. The MZ-38 sections for each shaft were placed and driven in 3 days.

Many bridge pier sites are adaptable to the construction of MZ-Steel Piling pier shafts, as illustrated here. Designed on sound engineering fundamentals this construction is considerably less expensive, less hazardous and requires a minimum of time to build. No cofferdams are needed, pier foundation loads are reduced, and actual construction can all be above water surface, either from floating equipment, trestles or as in this case, from the old bridge itself.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York


PLAN OF PIER TOP
ELEVATION OF BRIDGE OVER TUSCARAWAS RIVER
SECTION - AA
SIDE ELEVATION
TYPICAL ELEVATION STEEL SHEET PILING (MZ-38) PIERS
42'-6 ROADWAY WIDTH
MZ-38 SHAFT
STEEL SHEET PILING MZ-38 PIERS
SOUTH ABUTMENT
SOUTH PIER
CENTER PIER
NORTH PIER
NORTH ABUTMENT
TOP OF PIERS EL 881.51' TO 885.54'
REINF. CONCRETE CAP + PORTAL
TOP EL SIDE PILES
MZ-38 SHAFTS FILLED WITH CONC. TO BOTT. OF EXCAVATION
1" TIE RODS
1" HOOK BOLTS BELOW WATER FASTENED TO PILING BEFORE DRIVING
EXCAVATE SOFT MAT'L INSIDE SHAFT BEFORE FILLING WITH CONCRETE
SAND + LARGE GRAVEL SOME CLAY GLACIAL DEPOSIT
3'-0" WIDTH CONCRETE CAP ABOVE
DRIVE IN DIRECTION OF ARROWS
NOTE- ALL MZ-38 PILING WELDED TOGETHER ON OUTSIDE AT EACH INTERLOCK WITH 3/8" WELD, 3 INCHES LONG EVERY 12 INCHES FROM TOP OF PILE DOWN 8 FEET. MZ-38 PILING PAINTED OUTSIDE BELOW WATER LINE BEFORE DRIVING TO GRADE, THEN PAINTED TWO COATS GRAY PAINT COLOR TO MATCH CEMENT CAP.
BRIDGE DESIGNED H 20 LOADING OSHW SPECS.
LOAD PER PILE EACH SHAFT
DEAD LOAD SUPERSTRUCTURE 65 TONS
LIVE LOAD 75 TONS
TOTAL DEAD & LIVE LOAD 20 TONS

Mr. Geo. Arnold, County Engineer, was responsible for the design and construction. Wendling Bros. Construction Company of Dover, Ohio, were the general contractors. Burger Iron Company of Akron, Ohio, furnished the fabricated structural steel, while Carnegie-Illinois Steel Corporation supplied the MZ-38 steel sheet piling, I-Beam-Lok floor, T-Tri-Lok sidewalk and reinforcing steel.

ON BIG CONCRETE JOBS THEY'RE SAYING—

"tie faster with Richmond Ties"

Form-work requiring safe working loads of

3000 lb.
5000 lb.
9000 lb.
14000 lb.
25000 lb.

calls for Richmond Ties

The right ties for your needs and your form schedules can be figured to give you the best forms at the lowest ultimate form tie costs by the fifteen men in the Richmond Design and Estimate Department.

LOWER TIE COSTS—With Richmond Ties you use the most economical ties to fit your needs. They cost less than wire, band, or rod ties, and you buy only the ties. All working parts are returnable for full credit—without rental charges.

TIE FASTER—You can erect forms faster, strip quicker, space studs and walers wider, and use fewer ties with Richmonds.

BETTER FORMS—Richmond Ties are built to the strength your job demands. They maintain correct form alignment; and keep embedded metal up to two inches back from the finished face.

There are dollars to be saved by the use of Richmond Ties on the job you are now estimating. Without obligation, let us help you figure the form tie costs, for big jobs or residences.

SEE SWEET'S 3-51

TIME AND LABOR SAVING CONSTRUCTION DEVICES FOR CONCRETE CONSTRUCTION

RICHMOND SCREW ANCHOR CO., INC.
251 Bush Street
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CURRENT PERIODICAL LITERATURE

Abstracts of Magazine Articles on Civil Engineering Subjects

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

CONCRETE ARCH, AUSTRALIA. Long Bay Bridge. *Civ. Eng.* (*London*), vol. 34, no. 402, Dec. 1939, pp. 424–427. Design and construction of new single arch reinforced concrete bridge, span 344 ft, rise 83 ft, over Long Bay in Middle Harbor, Sydney, Australia; details of timber falsework; and cylinders; arch footings; demolition of old bridge.

HIGHWAY, GERMANY. Ein Grossbrueckenbau der Reichsautobahn, K. Schaechterle and R. Riedl. *Bauingenieur*, vol. 20, no. 49/52, Dec. 20, 1939, pp. 579–595, 1 supp. plate. Design and construction of major highway bridges along superhighways of Germany, including suspension bridge of 200-m span, and long plate girder bridge.

MILITARY. Military Bridges, P. W. Thompson. *Military Engr.*, vol. 32, no. 181, Jan.–Feb. 1940, pp. 14–18. Review of military bridge practice of German, British, and American armies; types of bridge equipage; German pneumatic boats; British light pontoon and trestle equipage; German, British, and American division load pontoon and trestle equipage; details of bridge assembly; box girder bridges; ferry equipage; connecting pieces.

PIERS, DESIGN. Le calcul de la résistance des piles de ponts a la poussée "cinématique" d'un courant, A. Broikos. *Génie Civil*, vol. 116, nos. 2999 and 3000, Feb. 3, 1940, pp. 87–89, and Feb. 10, pp. 102–104. Theoretical mathematical discussion of computation of resistance of bridge piers to kinematic pressure of stream.

RAILROAD, STRESSES. Do Higher Speeds Increase Stresses in Bridges? R. A. Van Ness. *Ry. Age*, vol. 108, no. 8, Feb. 24, 1940, pp. 364–367. Experiments undertaken by Atchison, Topeka and Santa Fe Railroad, which disclose beneficial effect of ballasted decks in lessening impact of fast-moving loads.

REVIEW. Roads, Bridges and Tunnels in 1939. *Engineer*, vol. 169, nos. 4382 and 4383, Jan. 5, 1940, pp. 21–24, and Jan. 12, pp. 30–31, supp. plate. Summary review of developments, particularly in bridges and tunnels in London area, Europe, Asia, Africa, and America.

STEEL ARCH, MISSISSIPPI RIVER. Tied Arches to Span Mississippi. *Eng. News-Rec.*, vol. 124, no. 11, Mar. 14, 1940, pp. 48–52. Design and construction of 5-span, steel arch highway bridge, 2,265 ft long, maximum span 540 ft, across Mississippi River between Rock Island, Ill., and Davenport, Iowa; foundations; structural details of tied arches, particularly box girder rib, H-section tie, and connection of two at piers; swinging of spans.

STEEL TRUSS, CALIFORNIA. Pit River Bridge Design, H. C. Olander. *Western Construction News*, vol. 15, no. 2, Feb. 1940, pp. 50–54. Design of double-deck, highway railroad bridge, having total length of 3,587 ft and featuring main piers which exceed 350 ft in height, to span arm of Shasta reservoir; maximum span 130 ft long; design of tall piers and superstructures; details of perforated steel plates for lacing.

STEEL, WELDING. All-Welded Steel Underbridge at Hainault, H. W. Clark. *Welder*, vol. 12, no. 72, Jan.–Feb. 1940, pp. 3–10. General scheme of one of new bridges built in connection with work now being carried out by London Transport on extension to Ongar; clear square span is 40 ft between faces of abutments; it is estimated that saving in weight of 20% in comparison with similar riveted design was made; material used was mild steel, in accordance with British Standard Specification No. 538.

WOODEN, CONSTRUCTION. Can Timber Be Preframed for Bridges? G. H. Trout. *Ry. Eng. & Maintenance*, vol. 36, no. 4, Apr. 1940, pp. 258–261. Author makes it clear that pre-framing of timber for bridges has not only proved itself practicable and economical on Union Pacific Railroad, but also that bridge and building forces of this road are now "sold" on this method of construction.

BUILDINGS

ANTI-AIRCRAFT PROTECTION. Application of A. R. P. to Future Buildings. *Structural Engr.*, vol. 18, no. 2, Feb. 1940, pp. 521–529. Report on discussion at December meeting of Institution of Structural Engineers on incorporation of anti-aircraft protection features in future buildings.

EXHIBITION BUILDINGS, WRECKING. Fall of House of Russia. Wreckers Salvage Soviet Building at Fair for Re-Erection in Moscow. *Construction Methods*, vol. 22, no. 3, Mar. 1940, pp. 46–49, 113–114, 116, and 118. Methods and equipment used in high-speed winter demolition of Soviet Pavilion at New York World's Fair; salvaging 1,700 tons of structural steel and 3,300 tons of valuable statuary, bas reliefs, stone, marble, metal, and mechanical equipment which had to be carefully packed in thousands of marked crates and cases.

STEEL, WELDED. All-Welded Machine Shop Frame Designed for Rapid Erection, S. H. Newburn. *Eng. News-Rec.*, vol. 124, no. 13, Mar. 28, 1940, p. 53. Construction of all-welded machine shop building recently completed by Dravo Corporation at Neville Island, Pittsburgh, Pa.; roof trusses detailed to facilitate fabrication and erection by welding to such extent that punched holes and erection bolts in field connections were almost wholly eliminated.

STEEL, WELDED. Standard Welded Connections for Steel Building Frames—III, IV, and V, D. V. Isaacs. *Commonwealth Engr.*, vol. 27, nos. 5, 6, and 7, Dec. 1939, pp. 177–185; Jan. 1940, pp. 211–219, and Feb., pp. 239–245. Discussion of modified form of connection for heavy joist reactions; and plate connections to columns; joist-to-joist connections; local stresses in connections; comparison of design assumptions and actual behavior of top restraining cleats; transfer of cleat loads into column shafts; column make-ups; weld stresses for top cleats; illustrative example involving several joists.

WRECKING. Condemnation and Demolition of Buildings in Connection with Slum Clearance, R. J. Wadsworth. *Bldg. Standards Monthly*, vol. 9, no. 2, Feb. 1940, pp. 4–7. Non-technical review of European and American methods of demolition of buildings in connection with slum clearance; need for demolition legislation.

CITY AND REGIONAL PLANNING

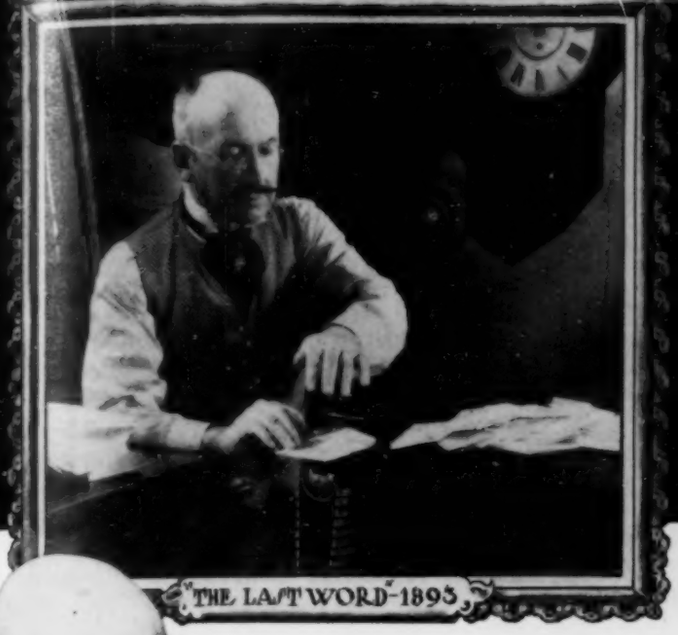
PITTSBURGH, PA. Remodeled Street Triples Traffic Room. *Eng. News-Rec.*, vol. 124, no. 13, Mar. 28, 1940, pp. 42–46. Description of proposed belt-line road for Pittsburgh's business district started by reconstructing old Water Street to carry 10 lanes of traffic; features of depressed and elevated roadways and of viaduct which is designed to resist deck uplift from floods; provisions for interchanging east- and west-bound local traffic, ramp access roads to wharf, and depressed freeway for through traffic; pavement design; construction methods.

SWEDEN. Town Planning and Local Traffic. *Ry. Gaz.*, vol. 72, no. 14, Apr. 5, 1940, pp. 507–510. International Congress at Stockholm, and account of present position and proposals for that city; map of Stockholm showing existing and proposed railway and street car systems given; pictorial presentation of Slussen cloverleaf road junction and traffic center in Stockholm.

CONCRETE

AGGREGATES. Processes Sand for Concrete, L. B. Mercer. *Commonwealth Engr.*, vol. 27, no. 7, Feb. 1, 1940, pp. 233–234. Importance of sand grading; details of equipment for both washing and classification; flowsheet of sand preparation plant at Grand Coulee Dam, Washington.

ANTI-AIRCRAFT PROTECTION, SHELTERS. Flooded "Anderson" Steel Shelters. *Surveyor*, vol. 97, no. 2507, Feb. 9, 1940, pp. 151–152. Recommended method of construction of poured-in-place concrete lining for keeping subsoil water out of "Anderson" steel anti-aircraft shelters.



"Why Lad, when I was your age that Addressograph was the last word."

"So was the nickelodeon, Pop. But the last word today is Progress."

"Maybe, Lad, but that old 'Addressograph' was a humdinger. Just give her the gun and, presto, your envelope was addressed and the next name on the belt shifted into place. THAT was Progress, Lad!"

"Fine, Pop. But this new 'Addressograph' turns out pay-rolls, tax applications, billing forms and other records—and its welded steel printing arm puts it years ahead in speed and quality of work."

"You're prejudiced for welding, Lad. I'm from Missouri."

"I'm prejudiced for Progress, Pop. I can show you sharper, more uniform printing and 10 good carbon copies per impression where it used to be 3, because deflection of the printing arm has been cut from .018 inch to .003 inch by going to welded steel."

"I'd say that's arming for increased sales, Lad. But I'd like to see the model they bring out when you're my age. Bet yours of today will then bring on the smiles like my old timer."

"You'll see Progress a'plenty before that, Pop. Many designers are just starting to go places with welding."

"But suppose my route to Progress isn't via *increased rigidity* of a printing arm."

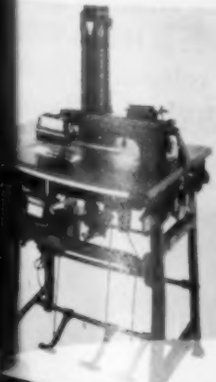
"OK. Suppose you're in the construction field. You can make headway via *stronger, stiffer buildings, bridges and other structures* and via *quick equipment repair for lower costs*. You can take the bee-line to Progress by lining up with the A-1 welding line of THE LINCOLN ELECTRIC COMPANY, Dept. H-25, Cleveland, Ohio. Largest Manufacturers of Arc Welding Equipment in the World."

ORMER MODEL. This "Addressograph" as been superseded by the streamlined, elded steel design shown. Parts such as e vertical magazine have been moved ay from the printing path for greater perating speed and wider range of pplication.

1/6 THE DEFLECTION. Above: former cast iron printing arm and base assembly. Weight 170 lbs. Deflection .018 inch. Below: new welded steel printing arm and base unit with box section as shown at left. Weight 70 lbs. Deflection .003 inch.

ELECTRODE PROGRESS. In line with Lincoln's progressive policy of ever reducing the cost of welding, this Company recently announced reductions up to 1½c per pound for "Fleetweld"—the world's most popular welding electrode. Write for latest price list.

PROGRESS IN BRIDGE REPAIR. Here's new strength and safety for the Monessen-Charleroi (Pa.) bridge. Cross beams are welded to stringers. Grid type flooring is welded to beams. *"Shield-Arc"* Welders and "Fleetweld" Electrodes used 100%.



LINCOLN ELECTRIC WELDING

READING

F. A. Heine

Chief Engineer, Bureau of Water, [illegible] of Reading, Pa., Member A. S. C. E., A. S. M. E. writes:

"Concerning the project for salvaging, reconditioning and relocating 36,000 feet of cast iron pipe completed last year. These pipes had been located under a heavily-traveled portion of the old Pottsville pike now superseded by a 3-lane concrete highway. The 36-inch pipe was laid from 1901 to 1908 and the 30- and 24-inch pipe was installed in 1889 — 51 years ago. More than 98% of this old pipe was salvaged and is now located in the earth shoulders of the new concrete highway. Reading has other cast iron pipe in service which was laid more than a century ago."

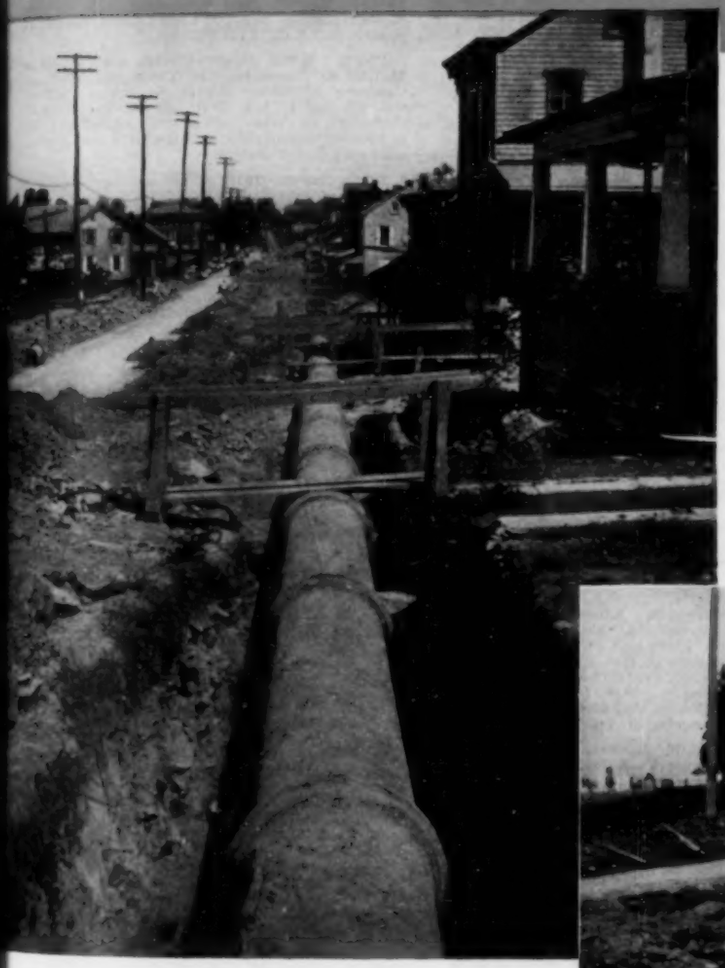
(*Below*) 18,000 feet of 30- to 40-year old, 36-inch cast iron pipe, salvaged and relocated. An additional 18,000 feet of 24-inch and 30-inch cast iron pipe was relocated. Upon completion the entire relocated line was tested in sections at hydrostatic pressure of 150 pounds. Hazen-Williams coefficient averaged better than 150.

(*Above*) **Reconditioned and relocated 36-inch cast iron pipe showing fittings and valve. After cleaning and coating the interiors with Bituminous coating, Hazen-Williams flow coefficients immediately after relocation, averaged better than 150 for both 36- and 30-inch pipe, in sections longer than 2,000 feet.**

THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER, 1013 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE

RELOCATES 7 MILES of 36-, 30-, and 24-inch Cast Iron Pipe and Salvages 98.5% of the old mains . . .



Mr. Heine's main problem was to relocate 7 miles of mains without interrupting the supply of water flowing into Reading and tapped by consumers along the Pottsville pike. The job was carried out with almost 100% uninterrupted service. Had the old pipe been abandoned, the estimated cost of 7 miles of new pipe would have been $350,000. Salvage value, long life and low maintenance are the three major economies of cast iron pipe.

re) 10,000 feet of 51-year old, 24-inch cast iron pipe sal-
and relocated.

ight) 8,000 feet of 51-year old, 30-inch cast iron pipe,
ged and relocated.

CAST Q IRON

Look for the "Q-Check" Registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

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CONSTRUCTION. Job Problems and Practice. *Am. Concrete Inst.—J.*, vol. 11, no. 5, Apr. 1940, pp. 513–518. Discussion of problems of concrete construction, including following: Design of reinforced concrete columns under eccentric loads, F. E. Richart; compressed air jets as means of placing concrete, W. F. Way.

CONSTRUCTION, TOLERANCES. Tolerances in Building Construction, J. R. Nichols. *Am. Concrete Inst.—J.*, vol. 11, no. 5, Apr. 1940, pp. 493–496. Suggestions as to allowable variation from exactly plumb, straight, level, and true for lines, levels, and dimensions of reinforced concrete buildings.

FROST RESISTANCE. Frost Resistant Concrete. R. B. Young. *Am. Concrete Inst.—J.*, vol. 11, no. 5, Apr. 1940, pp. 477–490. Study of causes of frost deterioration of concrete; suggestions for producing frost-resistant concrete.

MANHOLES. Advantages and Economies in Installation of Precast Manholes by Caisson Method, E. Williams. *Edison Elec. Inst.—Bul.*, vol. 8, no. 3, Mar. 1940, pp. 107–112. As dirt is excavated from within, manhole wall sinks; advantages of this type of construction are that no shoring is required, greater safety is provided for men within excavation, less material is stored in street during construction, etc.; economies of 20 to 35% have been achieved by using new method.

READY MIXED. Contribution of Ready-Mixed Concrete to Building Industry, H. F. Thomson. *Am. Concrete Inst.—J.*, vol. 11, no. 5, Apr. 1940, pp. 497–506. Development of commercial service in delivering ready-mixed concrete in urban centers; advances in quality of ready-mixed concrete; way toward further improvements in concreting practices.

ROADS AND STREETS. Improved Concrete Paving Practice, H. W. Richardson. *Eng. & Contract. Rec.*, vol. 53, no. 8, Feb. 21, 1940, pp. 53–57 and 63. Analysis of current concrete-paving equipment and methods; preparation of subgrade; forms and joints; aggregate production and batching; mixing, placing, and finishing.

ROADS AND STREETS. Modern Equipment and Scientific Control Speed Concrete Paving, W. C. Anderson. *Pub. Works*, vol. 71, no. 1, Jan. 1940, pp. 9–11 and 39–40. Description of up-to-date methods of constructing concrete highways, with special reference to construction of 16-mile project just opened between Charlottle, N.C., and Concord, N.C.

CONSTRUCTION INDUSTRY

UNITED STATES. A. G. C. 21st Annual Convention. *Constructor*, vol. 22, no. 2, Feb. 1, 1940, pp. 10–39. Proceedings of 1940 convention of Associated General Contractors of America, including Construction in Peace and War, L. Johnson; Labor and Contractors, J. P. Coyne; Federal Aid in Road Construction, W. Cartwright; Construction and Corps of Engineers, J. L. Schley; Highway Problems of Today, H. K. Bishop; A. G. C.'s 21st Year, E. J. Harding; What Public Buildings Administration Expects of Contractors, W. E. Reynolds; Reclamation Bureau and Contractors, J. C. Page.

DAMS

BUTTRESS, AUSTRALIA. Kiewa Dam Project, J. M. Antill. *Civ. Eng.* (*London*), vol. 35, no. 403, Jan. 1940, pp. 25–26 and 28. Features of reinforced concrete dam of slab and buttress type having height of 82 ft, over 260 ft in length, with spillway, 140 ft long in center of structure, being constructed by state of Victoria, Australia; design, placing, and curing of concrete.

CONCRETE. Special Cements in Sweden and in Large American Dams, B. Hellstrom. *Cement & Lime Manufacture*, vol. 13, no. 3, Mar. 1940, pp. 37–47. Review of Swedish and American experience with use of special cements in construction of concrete dams; heat of hydration and crack formation. From *Teknisk Tidskrift* (date not given).

CONCRETE ARCH, MADAGASCAR. Le barrage de Mantasoa, P. Hamon. *Travaux*, vol. 23, no. 84, Dec. 1939, pp. 451–458. Design and construction of reinforced concrete multiple-arch dam, 166 m long, maximum height 21 m, consisting of 22 arches of 5.5-m span, recently completed at Mantasoa, near Tananarive, Madagascar; method of testing waterproofness of concrete. See also *Engineering Index*, 1938, p. 306.

CONCRETE GRAVITY, CALIFORNIA. Veteran Dam of West Has Spillway Increased for Fourth Time, C. B. Neill. *Western Construction News*, vol. 15, no. 3, Mar. 1940, pp. 79–81. History of Sweetwater curved concrete-gravity dam near San Diego, Calif., completed in 1888; removal of parapet walls for central spillway, 345 ft long, to increase total spilling capacity to 70,000 cu ft per sec.

CRANES, MAINTENANCE AND REPAIR. Crane Servicing Procedure at Grand Coulee Dam. *Western Construction News*, vol. 16, no. 3, Mar. 1940, pp. 94–95. Maintenance of seven double cantilever (hammerhead) cranes and three whirler derricks used to place over 3,500,000 cu yd of concrete in Grand Coulee Dam during the past year; experience with use of pre-formed wire rope.

EARTH, CALIFORNIA. 65,000 Yards Daily at Hansen. *Eng. News-Rec.*, vol. 124, no. 15, Apr. 11, 1940, pp. 67–70. Progress report on construction of earth-fill Hansen Dam near Los Angeles, Calif.; description and performance of earth-compacting equipment; cost data.

EARTH, WYOMING. Grassy Lake Dam, I. D. Jerman. *Reclamation Era*, vol. 29, no. 12, Dec. 1939, pp. 340–345. Design and construction of earth-fill dam recently completed, 100 ft maximum height, also spillway of 1,206 capacity; placing of concrete at end of earth embankment.

FLOOD CONTROL

RIVERS, IMPROVEMENT. Effect of Shasta Dam on Navigation and Flood Control, F. M. S. Johnson. *Reclamation Era*, vol. 30, no. 2, Feb. 1940, pp. 38–41. Discussion of effect of Shasta Dam and additional structures on flood control and navigation conditions in Sacramento River, California; features of Sacramento weir and by-pass; Shasta flood control benefits.

SHORE PROTECTION, GREAT BRITAIN. Sea Defence and River Works in East Norfolk, K. C. Cotton. *Civ. Eng.* (*London*), vol. 35, no. 403, Jan. 1940, pp. 6–10. Description of shore protection structures, temporary and permanent, on East Norfolk coast of England, following floods of February 12, 1938.

FOUNDATIONS

BRIDGE PIERS, CONSTRUCTION. Caisson Procedure on Vancouver Suspension Bridge. *Eng. & Contract. Rec.*, vol. 53, no. 2, Jan. 10, 1940, pp. 13–15. Methods and equipment used in constructing main piers of Lion's Gate bridge, at Vancouver, B.C., 2,778 ft long.

PILES. Breve esame Critico dei Sistemi e Metodi di Fondazione in Terreni Cedevoli, S. Cannavo' di Paolo. *Annali dei Lavori Pubblici*, vol. 78, no. 1, Jan. 1940, pp. 35–48. Critical discussion of theory and practice of construction of foundations on yielding sites, with special reference to pile foundations.

PILES, STEEL. Bridge Piers of Structural Steel Piles Meet with Favor on C. N. R. *Ry. Age*, vol. 108, no. 12, Mar. 23, 1940, pp. 544–549. Article illustrates manner in which H-section steel bearing piles are now being used to replace obsolete masonry substructure.

PILES, STRESSES. Theorie van den kleefpaal, J. J. I. Sprenger. *Ingenieur*, vol. 55, no. 8, Feb. 23, 1940, pp. B.25–33. Theory of bond stresses in piles; theoretical, mathematical, and graphical analysis.

HYDRAULIC ENGINEERING

FLOW OF WATER, OPEN CHANNELS. Recherches sur l'écoulement de l'eau à l'éntree d'un canal découvert, L. Escande. *Génie Civil*, vol. 116, nos. 3003 and 3004, Mar. 2, 1940, pp. 152–154, and Mar. 9, pp. 164–166. Report on experimental study of flow of water through inlet to horizontal open channel of rectangular cross section; analysis of critical flow; mathematical analysis of actual, critical, and submerged flow in reentrant channel.

HISTORY. Leonardo da Vinci, Fondatore della Scienza Idraulica, G. Bellincioni. *Atti dei Sindacati Provinciali Fascisti Ingegneri di Lombardia*, vol. 17, no. 9, Sept. 1939, pp. 206–228. Review of fundamental contributions of Leonardo da Vinci to science and practice of hydraulics.

SOILS, EROSION. Place of Sedimentation Studies in Soil Conservation Service, J. L. Hough. *Mines Mag.*, vol. 30, no. 1, Jan. 1940, pp. 23–24, 29, and 45. Research program; cooperative laboratory at California Institute of Technology; studies inaugurated in 1934 were designed to furnish information on damages due to excessive sedimentation from accelerated soil erosion, to advance knowledge of natural laws governing erosion of soil by water, and to discover and evaluate methods of lessening or eliminating damages due to sedimentation.

WAVES. Oscillary Waves in Deep Water, C. F. Mitchim. *Military Engr.*, vol. 32, no. 182, Mar.–Apr. 1940, pp. 107–109. Results of experimental study, made at University of California Hydraulic Laboratory, of oscillatory waves, which are characterized by periodic, orbital motion of individual water particles; experimental check of wave theory as applied to simple oscillatory wave in deep water; bearing of these data on control of beach erosion.

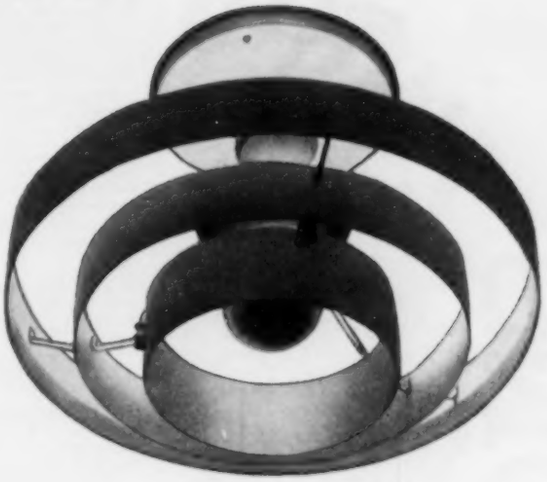
HYDROELECTRIC POWER PLANTS

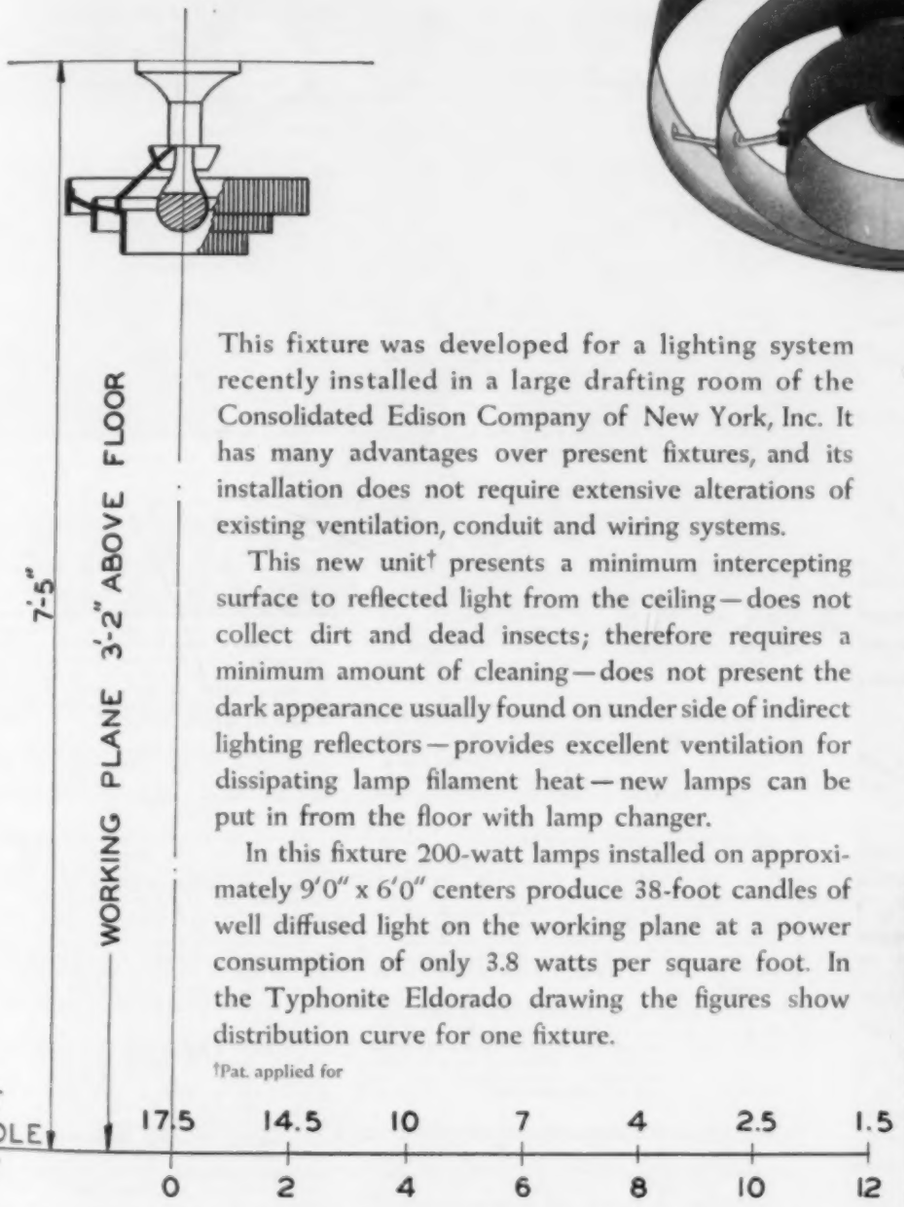
IRRIGATION CANALS, DROPS. Power Drops on All-American Canal, R. K. Durant. *Reclamation Era*, vol. 30, no. 2, Feb. 1940, pp. 46–49 and 52. Design and construction of four large drops on All-American Canal in Southern California, designed for future development of 46,000 kw in eight hydroelectric power plant units.

MEXICO. Two Dams in Mexico. *Engineer*, vol. 169, no. 4384, Jan. 19, 1940, pp. 54 and 64. Illustrated description of dams at Salinillas Lake in Nuevo Leon, and at Madero, Hidalgo, based upon information provided by A. Sandoval. Salinillas Dam takes advantage of drop in irrigation canal of Don Martin district into Lake Salinillas; plant has two units, each with double runner; horizontal shaft Francis turbine of 1,000

***TYPHONITE ELDORADO PENCIL PAGE**

NEW, INDIRECT LUMINAIRE IMPROVES DRAFTING-ROOM ILLUMINATION





This fixture was developed for a lighting system recently installed in a large drafting room of the Consolidated Edison Company of New York, Inc. It has many advantages over present fixtures, and its installation does not require extensive alterations of existing ventilation, conduit and wiring systems.

This new unit† presents a minimum intercepting surface to reflected light from the ceiling—does not collect dirt and dead insects; therefore requires a minimum amount of cleaning—does not present the dark appearance usually found on under side of indirect lighting reflectors—provides excellent ventilation for dissipating lamp filament heat—new lamps can be put in from the floor with lamp changer.

In this fixture 200-watt lamps installed on approximately 9'0" x 6'0" centers produce 38-foot candles of well diffused light on the working plane at a power consumption of only 3.8 watts per square foot. In the Typhonite Eldorado drawing the figures show distribution curve for one fixture.

†Pat. applied for

FREE—A blueprint from original Typhonite Eldorado drawings, giving essential installation and other important data concerning this new unit, will be sent upon request. Just write on professional letterhead to address below. Ask for blueprint No. 38-J6 (Note—This offer is good for 30 days after appearance of this advertisement.)

*TYPHONITE is a new form of natural graphite, used exclusively by Dixon in making leads for Eldorado pencils. Typhonite consists of extremely minute particles of controlled size produced by a whirlwind or typhoon of dry steam. This new exclusive Dixon process is one of the reasons why Eldorado pencils hold their points longer, give off freely, and make such opaque lines and figures.

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FOUNDATIONS

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SPENCER & ROSS, INC.—Detroit

hp at 360 rpm; dam at Madero provides reservoir in creek valley of 25,000,000-cu m capacity; dam is of rock-fill type.

IRRIGATION

CANALS, LINING. Asphaltic Concrete Lining for Irrigation Ditches. *Western Construction News*, vol. 16, no. 3, Mar. 1940, pp. 91–93. Results of field tests of asphaltic concrete lining for irrigation canals, carried out by U.S. Bureau of Reclamation and Asphalt Institute; details of methods used for installation on Yakima project; material characteristics; design of lining; construction operations; placing of lining.

CANALS, MAINTENANCE AND REPAIR. Improved Methods in Canal Maintenance, W. H. Robinson. *Reclamation Era*, vol. 30, no. 1, Jan. 1940, pp. 12–13. Review of evolution of methods and equipment of canal maintenance on old and new irrigation projects in United States; modern mechanized ditching and ditch-cleaning equipment.

HISTORY. Influence of Mechanical Mind on Development of Irrigation Through Ages, E. B. Ball. *Instn. Mech. Engrs.—Paper*, Mtg., Feb. 16, 1940, 7 pp., 8 supp. plates. Object of article is to illustrate ingenuity of mechanical engineers and importance of their influence on development of human race; illustrations showing various means of irrigation from earlier times, to present day.

SEWAGE DISPOSAL. Use of Sewage Effluents in Irrigation, W. A. Hutchins. *Pub. Works*, vol. 71, no. 1, Jan. 1940, pp. 32 and 34–35. Paper summarizing sewage irrigation practice in Western areas of United States, with special reference to its permissibility, desirability, and economic use; water rights in sewage. From *U.S. Dept. Agriculture—Tech. Bul. No. 675*, date not given.

SIPHONS. Inverted Siphons, Gravity Main Canal, E. A. Blout. *Reclamation Era*, vol. 30, no. 2, Feb. 1940, pp. 33–37. Description of two new circular reinforced concrete siphons with capacity of 2,200 cu ft per sec, recently constructed on gravity main canal for Yuma-Mesa division of Gila project in southwestern Arizona, to carry flow across Gila River and Fortuna, Wash., 10 miles east of Yuma, Ariz.; Gila siphon is 19 ft 6 in. in diameter and 2,000 ft in length; Fortuna siphon is 20.5 ft in diameter, 600 ft long.

MATERIALS TESTING

PILES. Enge beschouwingen over den puntweerstand van palen, G. C. Boonstra. *Ingenieur*, vol. 55, no. 8, Feb. 23, 1940, pp. B.33–45. Consideration regarding point resistance of piles; analysis of test results in Netherlands.

SOILS. Trailer Laboratory Speeds Soil Testing. *Eng. News-Rec.*, vol. 124, no. 15, Apr. 11, 1940, pp. 78–79. Description of traveling soil testing laboratory, mounted on trailer, developed by Maryland State Road Commission for soil and road materials tests not calling for central laboratory refinement and deliberation.

WELDING, STRUCTURAL STEEL. Examination of Welded Steel Specimens from Hasselt Bridge, L. Reeve. *Inst. Welding—Trans.*, vol. 3, no. 1, Jan. 1940, pp. 3–13. Report by members of R. II Sub-Committee on weldability of high tensile tructural steels of Welding Research Council of Institute.

MUNICIPAL ENGINEERING

AIRPORTS, NEW YORK. North Beach Airport New York's Municipal Field, B. Somervell. *Eng. News-Rec.*, vol. 124, no. 13, Mar. 28, 1940, pp. 61–72. Symposium on design and construction of North Beach Airport in New York (also known as La Guardia Field), consisting of following articles: Planning North Beach Airport; Laying-out Field; Major Structures at Airport.

SNOW REMOVAL. Round-Table Conference. *Roads & Bridges* (formerly *Can. Engr.*), vol. 78, no. 1, Jan. 1940, pp. 29–30. Practical discussion by several Canadian city engineers on following problem: When should snow removal work be started—as soon as storm commences or after it has subsided?

PORTS AND MARITIME STRUCTURES

BURMA. Improvements at Port of Rangoon. *Dock & Harbour Authority*, vol. 20, no. 231, Jan. 1940, pp. 53–58. Description of new wharf, 509 ft long, 140 ft wide, and other improvements at Port of Rangoon, Burma, constructed as part of £2,000,000 program; driving of reinforced concrete piles; installation of wharf crane and lifting appliances.

COFF'S HARBOR, AUSTRALIA. Port Improvements at Coff's Harbor, N.S.W., H. J. McMullen. *Commonwealth Engr.*, vol. 27, no. 7, Feb. 1940, pp. 250–253. Description of extensions to Coff's Harbor in New South Wales, Australia, 236 miles north of Sydney, including two breakwaters totaling 4,800 ft in length, reclamation wall, jetties, etc.

DOCKS, FLOATING. New Floating Dock at Durban, E. H. S. Salmon. *Dock & Harbour Authority*, vol. 20, no. 232, Feb. 1940, pp. 84–87. Description of new floating dock at port of Durban, South Africa, having lifting capacity of 4,000 tons, length 350 ft, width 88 ft; dock equipment; electrical installation; pumping machinery.

ITALY. Lavori di Ampliamento e Sistemazione nel Porto di Ancona. *Annali dei Lavori Pubblici*, vol. 78, no. 1, Jan. 1940, pp. 49–55. Recent extension of port of Ancona, Italy, including two breakwaters, sea wall, etc.

SEA WALLS. Construction of Sea Walls, S. C. Bailey. *Dock & Harbour Authority*, vol. 20, no. 232, Feb. 1940, pp. 97–101. Principles of design and construction of sea walls; computing wave pressure on walls; back filling; blockwork walls; reinforced walls; mass concrete walls; groins and aprons; calculations for walls.

SEA WALLS, CALIFORNIA. Concrete Sheetpile Walls Retain Canal Banks. *Construction Methods*, vol. 22, no. 3, Mar. 1940, pp. 66–68. Methods used in driving precast concrete tongue-and-groove sheet piles by skid driver with aid of water jet to form 11,273 ft of sea wall to replace damaged walls lining canals and boat basins bordering Alamitos Bay in Long Beach, Calif.

ROADS AND STREETS

BITUMINOUS. Road-Mix Versus Plant-Mix, J. G. Schaub. *Roads & Bridges*, vol. 78, no. 3, Mar. 1940, pp. 58 and 60. Discussion of reasons why Michigan State Highway Department has adopted plant-mix methods for its bituminous road program; drawbacks of road-mix; method of construction; costs.

BITUMINOUS. Towards Better Bituminous Roads, J. R. Benson. *Better Roads*, vol. 10, no. 2, Feb. 1940, pp. 27–29 and 36. Review of research on service behavior of asphaltic materials in roads and pavements; trends in use of materials, types of construction, mixing, and gradation of aggregates; use of predictive tests; improved aggregate design; manipulation of bituminous materials.

DESIGN. Getting Around in City of Future, C. Gordon. *Elec. Eng.*, vol. 59, no. 4, Apr. 1940, pp. 149–151. Improving transportation or circulatory system of modern city is discussed under heads: Capacity of city streets; effect of weaving on street capacity; effect of separating grades and increased speed. Capacity of lanes with various vehicles and experience data are given. Before Engineers Club, Baltimore.

EXCAVATING MACHINERY. Earth-Moving for Roads, W. S. Tomlinson, Jr. *Roads & Bridges* (formerly *Can. Engr.*), vol. 78, no. 1, Jan. 1940, pp. 26 and 65–66. Review of progress in design and operation of earth-moving equipment for road construction; tendency toward single unit; double handling; factors affecting costs; comparison of three methods of moving earth.

EXPRESSWAYS, CLEVELAND, OHIO. Lakefront Freeway Speeds Cleveland Traffic. *Eng. News-Rec.*, vol. 124, no. 15, Apr. 11, 1940, pp. 64–67. Description of new 6-mile Lakefront Freeway in Cleveland, Ohio, including continuous cantilever truss viaduct over downtown industrial area and Cuyahoga River, known as Main Avenue Bridge; discussion of effects on improvement of traffic conditions within Cleveland.

GRAVEL. Round-Table Conference. *Roads & Bridges*, vol. 78, no. 3, Mar. 1940, pp. 29–30 and 90–1. Discussion by Canadian engineers of desirable improvements in construction and maintenance of gravel roads.

GREAT BRITAIN. Winchester By-Pass, E. T. Hussell. *Civ. Eng. (London)*, vol. 35, no. 404, Feb. 1940, pp. 38–41. Design and construction of by-pass, costing £420,000, 7 miles long, for diversion of London-Southampton highway traffic.

HAWAIIAN ISLANDS. Pineapple Highway, J. Terry. *Roads & Streets*, vol. 83, no. 3, Mar. 1940, pp. 78 and 80. Description of 4-mile highway, 20 ft wide leading from harbor of Kaumalapau on southwest shore of Lanai island, to 1,200 ft above sea.

HIGHWAY ENGINEERING, GREAT BRITAIN. British Road Development and Its Effect on Modern Practice, J. G. Pidgeon. *Instn. Civ. Engrs.—J.*, no. 5, Mar. 1940, pp. 35–114, supp. plates. Review of British highway engineering factors; evolution of administrative machinery; traffic statistics and accident problem; road design and layout; maintenance, improvements, and new road and bridge construction; traffic signs; research and experimental work; street lighting.

HIGHWAY SYSTEMS. Highways of World, B. P. Root. *Roads & Bridges*, vol. 78, no. 3, Mar. 1940, pp. 65–66, 69–70 and 72. Discussion of statistical data on road mileage and number of automobiles in America, Europe, Africa, Asia, and Australia.

HIGHWAY SYSTEMS, GERMANY. Les Autoroutes en Allemagne, P. Kandaouroff. *Génie Civil*, vol. 116, no. 3006, Mar. 23, 1940, pp. 193–198. Engineering features of German superhighways; design and construction of German superhighway pavements; road construction specifications; roadside stations for travelers; traffic statistics.

HIGHWAY SYSTEMS, UNITED STATES. Highway Program for United States, T. H. MacDonald. *Am. Petroleum Inst.—Proc.*, vol. 20, Mtg., Nov. 9–17, 1939 (Automotive Taxation), pp. 16–18. Paper deals with ways and means of creating truly national highway program, without at-

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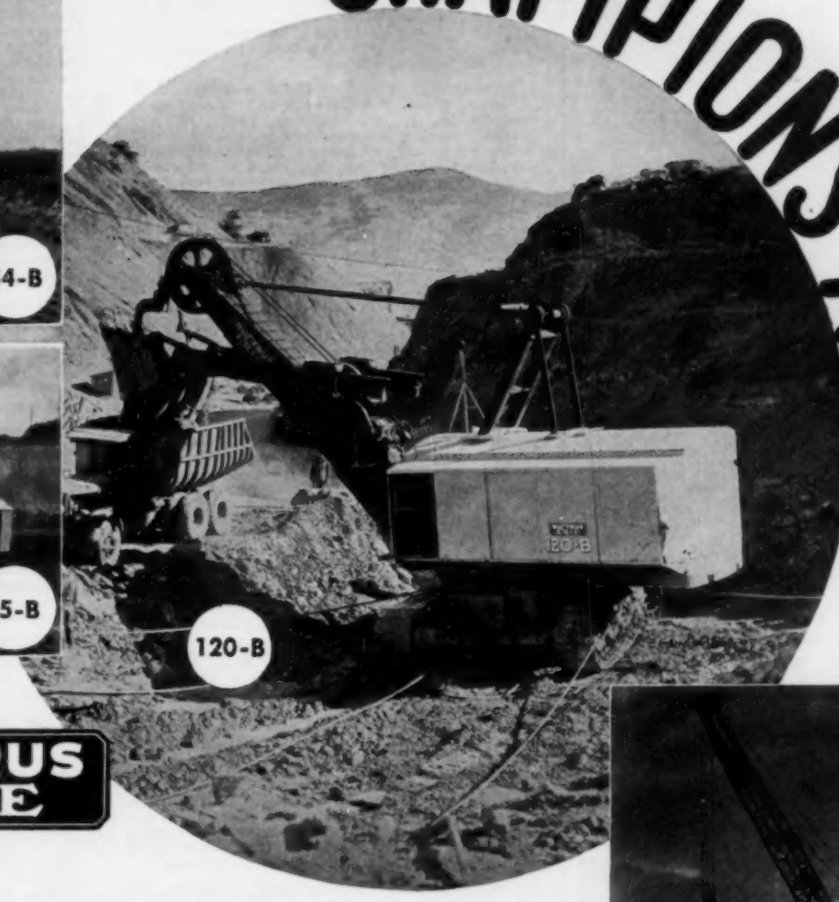

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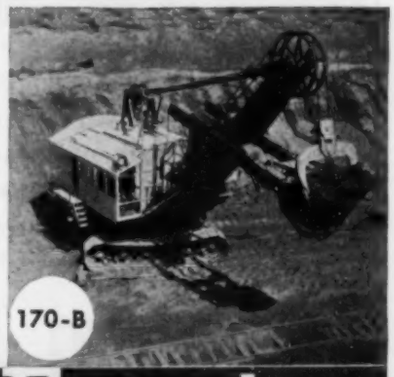

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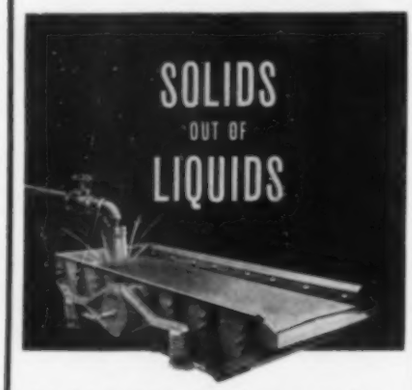

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tempted reference or comparison with other countries; principal elements for carrying on of continuous highway transport survey in all states; petroleum industry has vital interest in adoption of national highway program that best will serve and expand traffic facilities; recommended program.

ICE REMOVAL. Salt Breaks Ice Bond, A. C. Taspern. *Eng. News-Rec.*, vol. 124, no. 15, Apr. 11, 1940, p. 73. Discussion of practice of Sullivan County, New York, using rock salt for removal of ice from highway surfaces.

INTERSECTIONS. Safety at Intersections, V. S. Murray. *Roads & Bridges* (formerly *Can. Engr.*), vol. 78, no. 1, Jan. 1940, pp. 24–25, 82, and 84–86. Review of improvements in design and construction of highway intersections, with special reference to Canadian practice; new standards of highway design; sight distances at separations; horizontal and vertical clearances; overpasses vs. underpasses; types of structures used; lighting of grade separations; structures on divided highways; traffic circles; Toronto's western entrances.

LOW COST. Applying Soil Classification to Low-Cost Roadbuilding, O. L. Stokstad. *Better Roads*, vol. 10, no. 2, Feb. 1940, pp. 20–23. Review of practice of Michigan State Highway Department in applying results of soil surveys and classifications to design of low cost roads.

MAINTENANCE AND REPAIR. Safety by Remote Control, T. D. Goodale and W. S. Smith. *Nat. Safety News*, vol. 41, no. 4, Apr. 1940, pp. 10–11 and 76–77. Details of safety program developed by South Carolina State Highway Department to meet needs of widely scattered working force; departmental employees are scattered over 31,000 sq miles, comprising 46 counties, which are divided into four districts; each district has engineer and assistant, with county superintendents.

NEW HAMPSHIRE. From Railway to Highway, C. M. Brooks. *Roads & Streets*, vol. 83, no. 3, Mar. 1940, pp. 60 and 62. Utilization of 9 miles of abandoned track of Profile Branch of Boston and Maine Railroad in New Hampshire for construction of state highway.

NEW MEXICO, LOW COST. New Mexico's Double-Shot Surface Treatment, T. T. Mann. *Better Roads*, vol. 9, no. 12, Dec. 1939, pp. 19–21. Practice of New Mexico's State Highway Department in building low cost roads by using wearing top composed of mixture of local mineral aggregate and asphaltic road oil; checking smoothness of base.

PARKWAYS. Merritt Parkway, C. G. Nichols. *Roads & Streets*, vol. 83, no. 3, Mar. 1940, pp. 66 and 69–70. Notes on operation of recently completed Merritt Parkway from New York State line, to Nicholls, Conn., 34 miles long.

PENNSYLVANIA. Pennsylvania Turnpike, W. E. Woodruff. *Constructor*, vol. 21, no. 12, Dec. 1939, pp. 10–23, supp. map. Construction of Pennsylvania Turnpike described in several previously indexed articles; labor relations; accident prevention; excavation; structures; paving; tunnels.

RAILROAD CROSSINGS. Federal Grade-Crossing Program Shows Quickened Pace. *Ry. Age*, vol. 108, no. 10, Mar. 9, 1940, pp. 433–437. Article describes progress made in rail-highway grade-crossing elimination and protection program of federal government and tells of other developments made to solve right-of-way problems and to perfect formula for determining hazard ratings.

RAILROAD CROSSINGS, CALIFORNIA. Unique Framing for Skew Overpass. *Eng. News-Rec.*, vol. 124, no. 13, Mar. 28, 1940, p. 55. Description of ingenious framing plan on sharply-skewed overpass recently built by California Division of Highways to eliminate grade crossing on main line of Southern Pacific system south of Turlock.

ROAD MACHINERY. Hard Surfaced Earth Roads Built by Heat Treatment. *Eng. & Contract. Rec.*, vol. 53, no. 5, Jan. 31, 1940, pp. 12–14. Description of heat-treating Rapler-Irvine road machine depending upon principle that, by application of intense heat, almost any soil can be converted into brick-like material which is suitable for roadmaking.

ROAD MACHINERY, UNITED STATES. Modern Grading Equipment and Practices, M. V. Burton. *Eng. & Contract. Rec.*, vol. 53, no. 8, Feb. 21, 1940, pp. 43–48. Review of displays of 1940 Chicago Road Show; latest improvements in road machinery; power shovels; scrapers; equipment for compaction of fills; selecting hauling equipment; detachable buckets for trucks.

SOILS, SURVEYS. Soil-Survey Practices of States, L. Muir and W. F. Hughes. *Better Roads*, vol. 9, no. 12, Dec. 1939, pp. 25–26 and 38. Summary of current procedures of state highway organizations, in making subgrade surveys and applying data derived from same.

SNOW REMOVAL. Snow Drift Control by Highway Design. *Roads & Streets*, vol. 83, no. 3, Mar. 1940, pp. 45–48. Experimental studies of highway construction in its relation to snow-drift control, made by Engineering Experiment Station of Michigan State College of Agriculture and Applied Science through laboratory wind tunnel study of air flow across models of various types of highway cross sections; relationship between height and slope of embankment and eddy area; effect of rounding top and bottom of embankment slope.

STABILIZATION. Plant-Mixed Stabilized Aggregate for Michigan Secondary Roads, F. R. Olmstead. *Better Roads*, vol. 10, no. 1, Jan. 1940, pp. 25–28 and 45–46. Designing and controlling stabilized mixtures of road materials; test methods for control of plant mix production in Michigan; gradation limits for design of Michigan stabilized mixtures; equipment and materials for stabilization with binder soils; estimation of quantities of stabilized mixtures; placement and compaction of stabilized materials.

WIDENING. Nieuw systeem winkelstraatverbreeding, M. L. van der Schaaff. *Ingenieur*, vol. 55, no. 6, Feb. 9, 1940, pp. B.22–24. New system for widening shopping streets; shops are reconstructed in such manner that fronts are used as entrance halls which subsequently are united into one single arcade.

SANITARY ENGINEERING

HOTELS. Sanitary Standards for Hotels, G. E. Arnold. *Am. Water Works Assn.—J.*, vol. 32, no. 3, Mar. 1940, pp. 456–464. Discussion of water supply and sewage disposal standards for hotels; precautions for handling food; swimming pool precautions.

REFUSE DISPOSAL, RECLAMATION OF LAND. Health Experts Endorse Landfills and Recommend Best Practice. *Eng. News-Rec.*, vol. 124, no. 13, Mar. 28, 1940, pp. 54–55. Excerpts of report by Board of Health experts appointed to study land-fill practice in New York City, stating that these operations do not constitute hazard to public health or safety now or in future; but that on contrary certain potential public health hazards obtaining previously at sites of these fills are diminished, since filling is one of best methods of controlling rats and mosquitoes in marshes and swamps.

SEWERAGE AND SEWAGE DISPOSAL

CANADA. Sewage Disposal in Canada, A. E. Berry. *Water & Sewage* (formerly *Can. Engr.*), vol. 78, no. 1, Jan. 1940, pp. 14–15 and 46–50. Review of development of sewage disposal and survey of sewage disposal practice in Canada, compared with practice of other countries; statistical data.

DISPOSAL PLANTS, DESIGN. Selecting Sewage-Treatment Process, A. Potter and M. H. Klegerman. *Water & Sewage*, vol. 78, no. 2, Feb. 1940, pp. 14–16 and 47–49. Principles of selecting process of sewage disposal illustrated by designs of sewage disposal plants for Elizabeth River Valley, N.J.; Westhaven, Conn.; and Fallsburg, N.Y.; determining extent of treatment; influence of sewage characteristics.

DISPOSAL PLANTS, LAKE GEORGE, N.Y. Complete Sewage Disposal for Small Community, M. Vrooman, Jr. *Water Works & Sewerage*, vol. 87, no. 3, Mar. 1940, pp. 130–133. Description of new sewage disposal plant of Lake George, N.Y., designed to serve variable population fluctuating from 1,500 in winter to about 5,000 in summer; features of sewage tanks and sewage pumping stations.

DISPOSAL PLANTS, MAINTENANCE AND REPAIR. Handling Three Nuisances: Flies, Pooling, and Weeds. *Mun. Sanitation*, vol. 11, no. 2, Feb. 1940, pp. 91–92 and 121. Practical discussion by sewage plant superintendents of methods, frequency, and effectiveness of filter fly control; control of pooling on trickling filters; control of weed growths.

DISPOSAL PLANTS, MANAGEMENT. Pointers on Sewage Disposal Service, P. A. Smith. *Eng. News-Rec.*, vol. 124, no. 11, Mar. 14, 1940, pp. 71–73. Administration and operating practices in providing cooperative sewage disposal facilities for 12 communities in New Jersey; public relations, personnel policies, business methods, and operating procedures.

DISPOSAL PLANTS, MUNCIE, IND. Modern Sewerage Works for Muncie, A. A. Burger. *Mun. Sanitation*, vol. 11, no. 2, Feb. 1940, pp. 85–87. Description of new 42-mgd sewerage system of Muncie, Ind., population 50,000, featuring pre-settling tanks and spherical gas holder having capacity of 35,000 cu ft.

DISPOSAL PLANTS, OPERATION. Troubles from Drought and Heavy Rainfall. *Mun. Sanitation*, vol. 11, no. 3, Mar. 1940, pp. 160–161. Practical discussion by superintendents of sewage disposal plants, on effects of prolonged drought and heavy rainfall on sewage plant operation.

DISPOSAL PLANTS, PREFABRICATED. Package Delivery Waste Treatment Plants, E. B. Mallery. *Water Works & Sewerage*, vol. 87, no. 3, Mar. 1940, pp. 102–106. Description of all-steel factory fabricated sewage treatment plant to accommodate small load, manufactured by Lancaster Iron Works, Inc., Lancaster, Pa.; course of liquid and sludge through 2-stage plant treating wastes that require no preliminary settling; course of treatment through 2-stage plant providing primary settling followed by bio-flocculation

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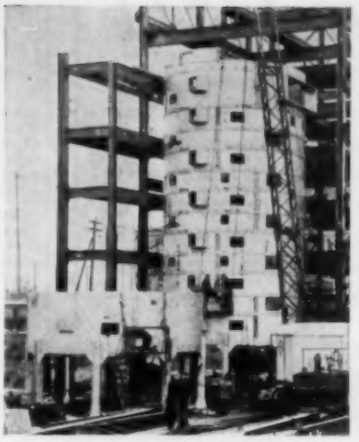

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DISPOSAL PLANTS, TORONTO, ONTARIO. New Disposal Plant for Toronto's Sewage, *Water & Sewage* (formerly *Can. Engr.*), vol. 78, no. 1, Jan. 1940, pp. 22 and 54–56. Features of proposed new 84-mgd sewage disposal plant for Toronto, Ontario, estimated to cost over $5,000,000; present disposal works; treatment plant data.

GAS RECOVERY. Utilization of Gas from Sewage Sludge, A. E. Berry. *Water & Sewage*, vol. 78, no. 2, Feb. 1940, pp. 9–10, 40, and 42. Review of recent experience in United States and in Canada with recovery and utilization of gas from sewage sludge; uses for gas; composition of gas; use of gas for heating sludge; gas engine installations; methods of using engines; storage of gas; economy of sludge gas.

LABORATORY CONTROL. Sewage Treatment Plant Tests, and Results. *Mun. Sanitation*, vol. 11, no. 4, Apr. 1940, pp. 201–220. Discussion, by superintendents of sewage disposal plants, of value of tests of raw sewage, effluents, sludge, screenings, and of diluting stream.

REFUSE DISPOSAL, DIGESTION. Disposal of Garbage with Sewage, K. C. Lauster. *Pub. Works*, vol. 71, nos. 1 and 2, Jan. 1940, pp. 25–26, (discussion) Feb., p. 38. Excerpts from paper before North Dakota Water and Sewage Works Conference discussing methods of disposing of garbage with sewage; composition of garbage; theoretical sewage garbage digestion capacity.

SEWAGE ANALYSIS. Sewage Tests that Aid in Treatment Plant Operation, A. V. Delaporte. *Eng. & Contract Rec.*, vol. 53, nos. 3 and 5, Jan. 17, 1940, pp. 31–33 and Jan. 31, pp. 25–26. Methods of sewage examination; sampling; determination of nitrogen, chlorine as chlorides, dissolved oxygen, solids, settleable solids, biochemical oxygen demand; etc. Before Can. Inst. Sewage & Sanitation.

SEWERS, LEAKAGE. Sewer Infiltration and Its Measurement—Symposium. *Pub. Works*, vol. 71, no. 3, Mar. 1940, pp. 40–41 and 44–45. Symposium on measurement of sewer infiltration, including following articles: Method of Testing for Infiltration and Exfiltration in Sewer Lines, W. L. Dunn; Measuring Flows in Cranford, N.J., T. J. McLaughlin; Specifications on Leakage Tests, H. E. Norris; Testing Procedure in Irvington, N.J., I. J. Casey, Jr.

SEWERS, MAINTENANCE AND REPAIR. Sewer Maintenance, C. G. Andersen. *Water Works & Sewerage*, vol. 87, no. 1, Jan. 1940, pp. 27–32. Practice of sewer maintenance at Rockville Centre, N.Y.; sewer cleaning; mapping and program setting; flushing; roots in service connections; pump stations; maintenance costs.

SEWERS, MAINTENANCE AND REPAIR. Sewer Maintenance Hints. *Eng. News-Rec.*, vol. 124, no. 11, Mar. 14, 1940, pp. 78–79. Discussion of sewer maintenance program and methods to cope with root clogging, sediment deposits, and infiltration troubles.

SEWERS, OUTFALL. Hydraulic Problem Concerning Design of Sewage-Storage Tanks, and Sea-Outfalls, J. R. Daymond. *Instn. Civ. Engrs.—J.*, no. 3, Jan. 1940, pp. 217–236, supp. plate. Discussion of hydraulic problems connected with design of sea-outfall sewerage schemes involving storage in tanks for period of tide lock; results of tests on sewer outfall models; discussion on value of experimental results.

SEWERS, RENTALS. Sewer Rental Financing, W. Storrie. *Water & Sewage*, vol. 78, no. 3, Mar. 1940, pp. 46, 48–52, and 54–55. Discussion of practice of making special charges for use of sewerage system which are collected through added charge on water works bill; sewer rental basis; rate structures; experience in Buffalo, N.Y.; disposition of sewer rental revenues as reported by 42 cities; use of sewer rental revenues; legislation necessary. Before Am. Water Works Assn.

SLUDGE. Activated Carbon Aids Sludge Dryings, G. J. Wiest. *Mun. Sanitation*, vol. 11, no. 3, Mar. 1940, pp. 140–142. Experience of sewage disposal plant of Lancaster, Pa., with treatment of sludge with activated carbon to accelerate drying process; alum treatment of sludge; comparison of rates of sludge drying.

SLUDGE. Sludge Filtration and Incineration. *Eng. News-Rec.*, vol. 124, no. 11, Mar. 14, 1940, pp. 75–78. Operation of sludge disposal equipment at Buffalo and at Minneapolis-St. Paul sewage treatment plants; equipment performance; incinerator-abrasion troubles; multiple-hearth incineration.

SLUDGE. Sludge Incineration at Columbus. *Mun. Sanitation*, vol. 11, no. 4, Apr. 1940, pp. 185–186. Description of mechanically rabbled, multiple-hearth-type sludge incinerator, recently installed in Columbus, Ohio, designed to dry and incinerate 80 tons per day of sewage sludge filter cake, containing 75% moisture, 12½% combustible matter, and 12½% ash; arrangement of sludge incinerator and air preheating system.

UNDERGROUND, MANHOLES. Manholes by Caisson Method. *Eng. News-Rec.*, vol. 123, no.

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13, Mar. 28, 1940, p. 49. Description of system of manhole construction developed by Consolidated Edison Co., New York City; precast concrete boxes, up to 11 ft by 4 ft 2 in. by 6 ft 6 in., installed for manholes and subsurface containers for electrical appliances by setting box over its proposed location, then digging through it with clamshell bucket permitting box to sink due to its own weight.

UNITED STATES. Disposal of Sewage and Industrial Wastes Developments and Trends in 1939. F. W. Mohlman. *Water Works & Sewerage*, vol. 87, nos. 2 and 3, Feb. 1940, pp. 47–58 and Mar. pp. 93–101. Review of developments and equipment costs in sewage disposal in United States; improvement of clarification processes, chemical treatment, trickling filters, gas recovery, etc.; sludge concentration, dewatering drying, and incineration; fertilizer production; safety and plant maintenance; packing house and stockyard wastes; other industrial wastes; rates of charge for waste treatment; books on industrial wastes; economics of disposal.

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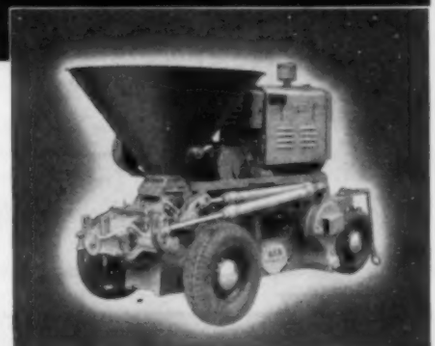

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